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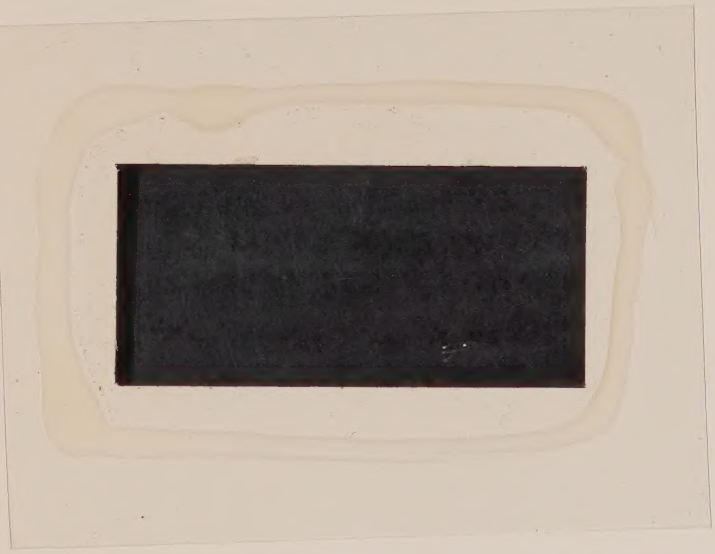
PACE®

PRECISION ANALOG COMPUTING EQUIPMENT

ELECTRONIC ASSOCIATES INCORPORATED

LONG BRANCH, NEW JERSEY

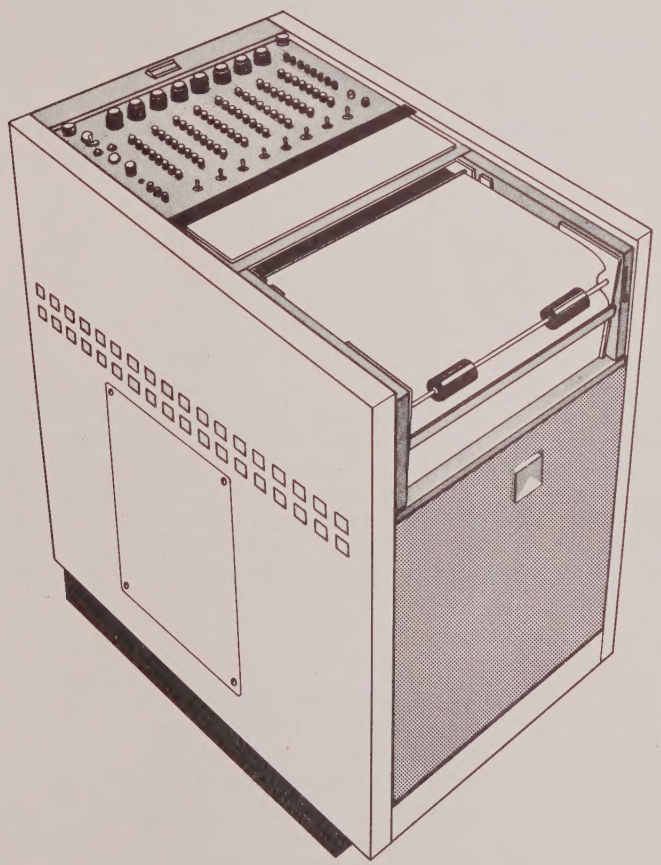


CHARLES MAXSON

8 Channel Recorder

MODEL 1902D

LONG BRANCH, NEW JERSEY TELEPHONE CAPITAL 9-1100



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1. Please specify the type number and serial number of the basic unit as well as the identification of the part when inquiring about replacement items as potentiometer assemblies or cups, relays, transformers, precision resistors, etc.

2. When inquiring about items as servo multipliers, resolvers, networks, cables, potentiometer expansions, etc., please specify the serial numbers of the major equipment with which the units are to be used, such as: Console Type 16-31R, serial #000, or Amplifier Group Type 16-31C, serial #000, etc. If at all possible, please include the purchase order number or the EAI project number under which the equipment was originally procured.

Your cooperation in supplying the required information will facilitate the processing of your requests and aid in assuring that the correct items are supplied.

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7-20-59

The following color code is now in use to facilitate the identification of manuals when only the backs are visible. (The color indicated is that of the plastic binder.)

COLOR	*TYPE OF EQUIPMENT*
Tan	*Multipliers, Resolvers*
Maroon	*Amplifiers*
Orange	*Variplotters*
Blue	*Computers*
Red	*Voltage Sources (Power Supplies, Reference Supplies)*
Black	*Special (Digiverters, etc.)*
White	*Non-Linear (Diode Function Generators, Pot Padders)*

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I. DESCRIPTION

a. General. The Electronic Associates Inc. Eight Channel Recorder Model 1902D (fig. 1 and 2) is comprised of the Brush Eight Channel Oscillograph Model RD 2784-01, a d-c amplifier for each channel, and all necessary power supplies and control circuits. Eight variables can be plotted simultaneously against time, as represented by the motion of the chart paper. The hot wire method of recording is used and the records are readily reproduced by the Ozalid process.

The recorder can be used separately or in conjunction with a computer, in which case the recorder can be controlled from the computer, and vice versa. Sensitivity and paper speed are controlled by pushbutton switches on the control panel.

b. Technical Information.

Power Requirements

117 volts, 60 cycle, single-phase
420 vatts.

Physical Specifications

Height	36 inches (front), 38 1/2 inches (rear)
Width	21 inches
Depth	30 1/2 inches

Weight, crated

310 pounds

Weight, uncrated

250 pounds

(1) On the control panel each sensitivity control button is marked on one side with the deflection sensitivity in volts per millimeter and on the other with the full scale deflection available with that degree of sensitivity. The sensitivity of each channel is separately adjustable in eight steps as listed in Table I.

(2) Standard Brush opaque or transparent chart paper is used. Chart speed is also pushbutton controlled with the following steps available: mm/sec. - 0.4, 0.8, 2, 4, 10, 20, 50, 100.

The chart can be started or stopped at the recorder, at the computer, or at some remote point.

(3) Recording error for the center 20 mm of deflection is ±0.5% of full scale deflection, or less than interpretation error which makes it negligible. Over full scale deflection error is less than ±2% of full scale. Full scale deflection is 40 mm.

TABLE I

Sensitivity	Full Scale Deflection
10 volts/mm	±200 volts
5 volts/mm	±100 volts
2.0 volts/mm	± 40 volts
1.0 volts/mm	± 20 volts
0.5 volts/mm	± 10 volts
0.2 volts/mm	± 4 volts
0.1 volts/mm	± 2 volts
0.05 volts/mm	± 1 volt

(4) Frequency response can be made essentially flat to 40 cycles by adjusting the Frequency Response control for each channel located on the d-c amplifier network (12.091). Figure 3 shows the frequency response for the extreme counterclockwise and clockwise positions of the control.

c. Special Features.

(1) The Event Marker can be used to mark the chart at one second intervals.

(2) The built in Calibrate Unit (48.002) provides an accurate method of checking the sensitivity setting of all channels simultaneously. Accurate calibration voltages for all sensitivity ranges can be applied by step-by-step manual operation, or automatically in sequence.

The Calibrate Unit has 20 steps; step 1 is the "home" position. The Calibration voltage connected to all channels at each step is described in Table 2.

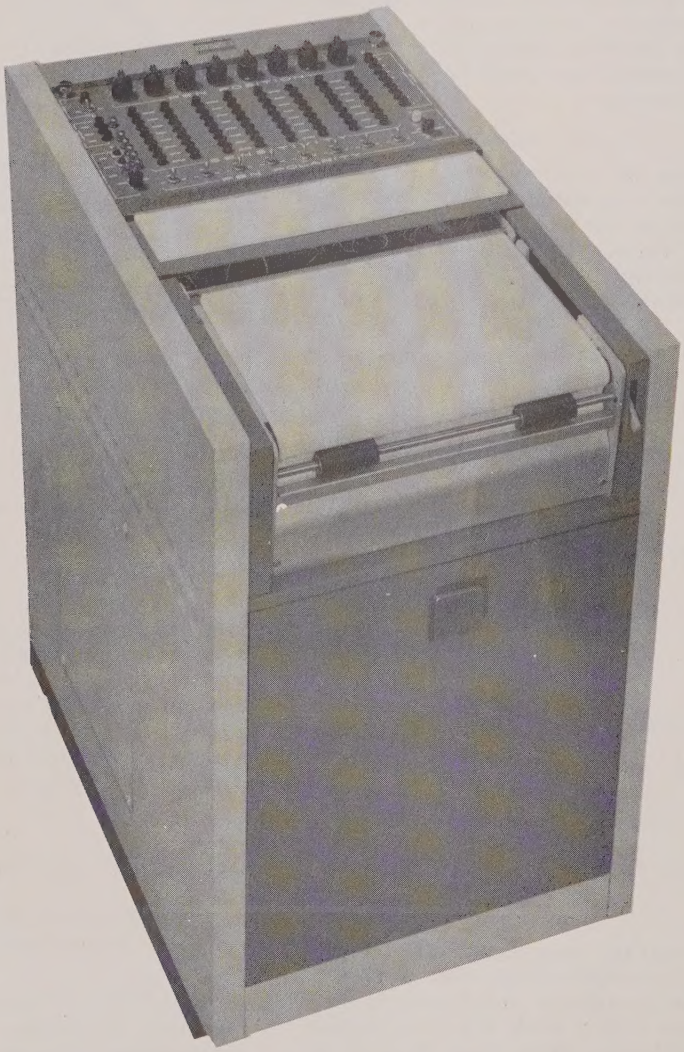


Figure 1. Front View - 8 Channel Recorder.

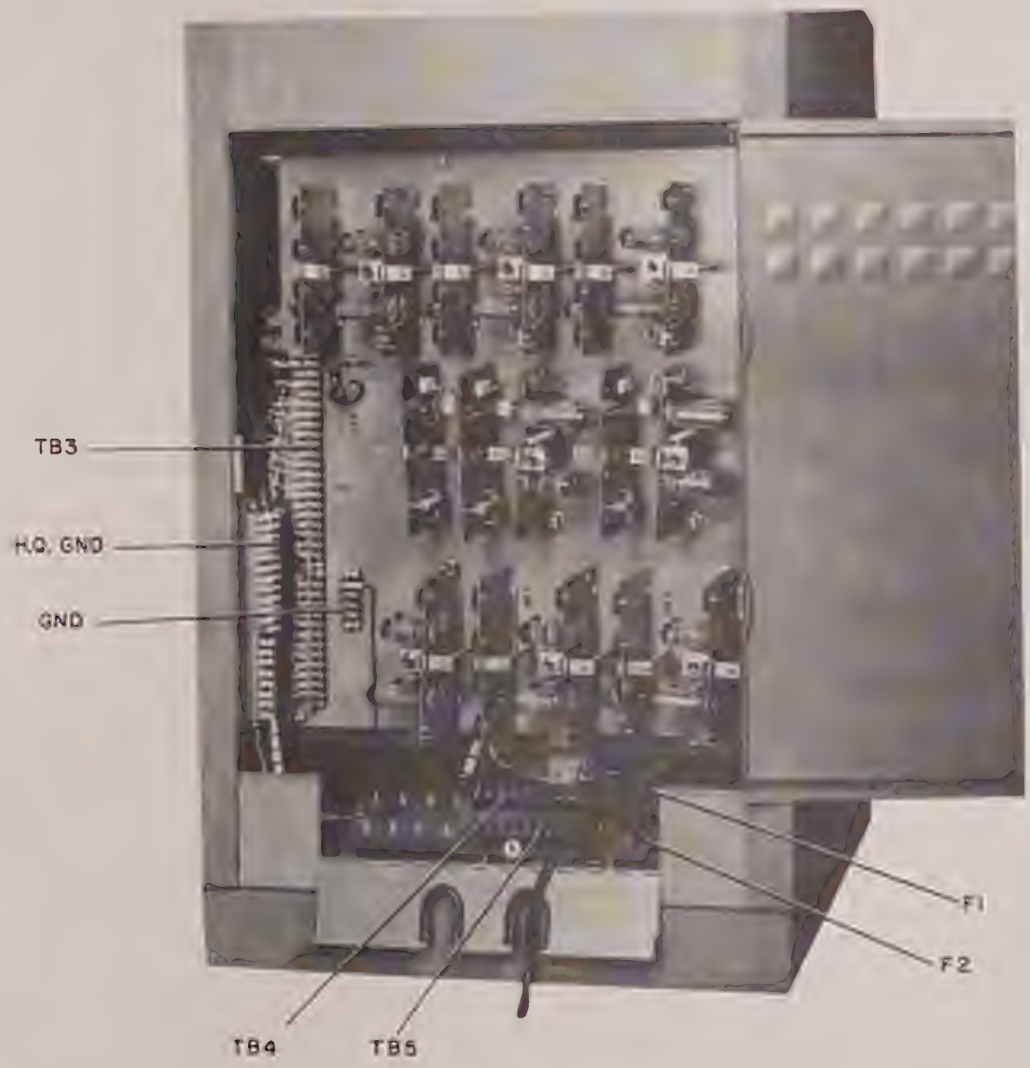


Figure 2. Eight Channel Recorder, rear view.

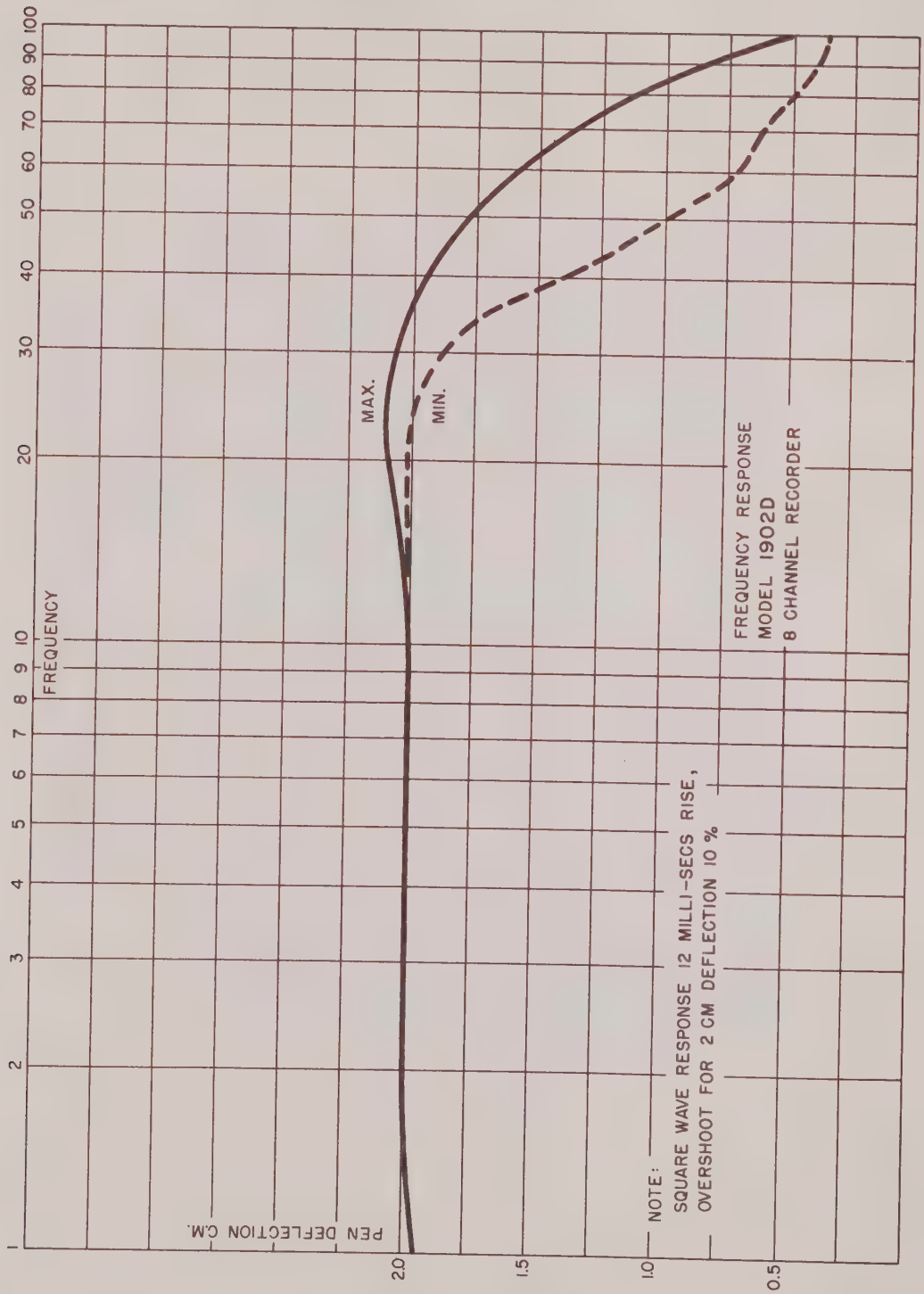


Figure 3. Frequency Response.

TABLE II	
Step	Volts
1	0 ("HOME")
2	-10
3	0
4	-1
5	-2
6	-4
7	-10
8	-20
9	-100
10	0
11	0
12	+10
13	0
14	+1
15	+2
16	+4
17	+10
18	+20
19	+100
20	0

d. List of Components. The recorder Model 1902D includes the following components:

Quantity	Component
1 each	Brush 8 channel Rectilinear Oscillograph Model RD 2784-01
1 each	Control Panel 20.050
1 each	Calibrate Unit 48.002
2 each	Regulated Power Supply 10.014
2 each	Regulator Amplifier 3033 - 10AA- 2
1 each	Event Marker and Filament Supply 36.001
1 each	Relay Chassis 11.039
8 each	D-C Amplifier 3033-6A-3
8 each	Network 12.091
1 each	Cable 19.014 (Recorder 1902D to 231R Console - Control)
1 each	Cable 19.015 (Recorder 1902D to 231R Console - Signal)

2. INSTALLATION

a. Packaging. The Eight Channel Recorder Model 1902D (99.003) is shipped completely assembled. The following accessories are included with the recorder.

Quantity	Description
1 roll	Opaque Chart Paper Brush RA 2984-30
1 roll	Transparent Chart Paper Brush RA 2984-35
1 each	Gram Gauge
1 each	Pen Tool - (True Arc Pliers)
1 each	Recorder Cover
2 each	Spare Stylus Brush #RA 2824-31
1 each	Manual on Brush Recorder
5 each	Writing Pads B099 087 0

b. Unpacking. In removing the parts from the packing, do not allow tools to come into contact with the equipment. Be sure that all items are accounted for before discarding the packing material.

c. Installation.

(1) Chart paper, Pens. Instructions for installing chart paper are given on page 2 of the Brush Instruction Book RD 2784 01 supplied with the equipment. Directions for mounting the pens are given on page 3. For any information concerning the Brush Rectilinear Recorder Model RD 2784-01, reference should be made to this booklet. When installing pens, make sure pen pressure is between 1/2 - 3/4 gram. Under no circumstances should it exceed 3/4 gram.

d. Electrical Connections.

(1) Independent Operation.

(a) Make connections to the coaxial jacks J20 through J27 on the terminal plate at the rear of the recorder, as shown below (see fig. 2).

Input #1	J20 — A
Input #2	J21 — B
Input #3	J22 — C
Input #4	J23 — D
Input #5	J24 — E
Input #6	J25 — F
Input #7	J26 — L
Input #8	J27 — V
+100 ref	TB5-6 — U
-100 ref	TB5-7 — S

(b) Set the controls as shown in Table III.

TABLE III	
Control	Position
POWER	OFF
COMPUTER CONTROL	RESET
CALIBRATE	OFF
CHART SPEED	2 mm/sec.
RECORD	
PEN POSITION	OFF
PEN POLARITY	OFF
SENSITIVITY	

(2) Operation with Computer 231R. Signal cable 19.015 is connected to the recorder at TB5 and the coaxial jacks adjacent to it. The terminal number destination and use of each conductor in the cable is shown on drawing B019 015 0A. The other end plugs into jack RJ on the computer console. Control cable 19.014 connects to TB4 at the rear of the recorder, and the other end to jack BT on the computer. The drawing number for this cable is B019 014 0A.

e. Initial Checks and Adjustments.

(1) Power Supplies. Turn POWER switch to ON. Allow 60 seconds for Time Delay Relay K3 to operate. Open the rear door of the recorder; on the left is TB3. Terminals on this strip connect to the power supplies, as follows:

TB3-5	±ground
TB3-7	-300 volts
TB3-8	+300 volts

Connect a meter across the +300 volt supply and rotate the VOLTAGE ADJUST potentiometer on the Regulator Amplifier (3033-10AA-2) until the meter reads 300. The Regulator Amplifier is the plug-in unit on the +300 volt power supply (see fig. 4). Repeat this operation on the -300 volt supply.

(2) D-C Amplifier. Depress the PUSH-TO-BALANCE switch (S1) and rotate the BALANCE ADJUST potentiometer until the OVERLOAD BALANCE INDICATOR goes out (see fig. 5). It is not necessary to balance the amplifiers frequently. A daily check is adequate.

CAUTION:

Potentially dangerous voltages are present on this card. Only the switch button and balance adjust potentiometer should be touched.

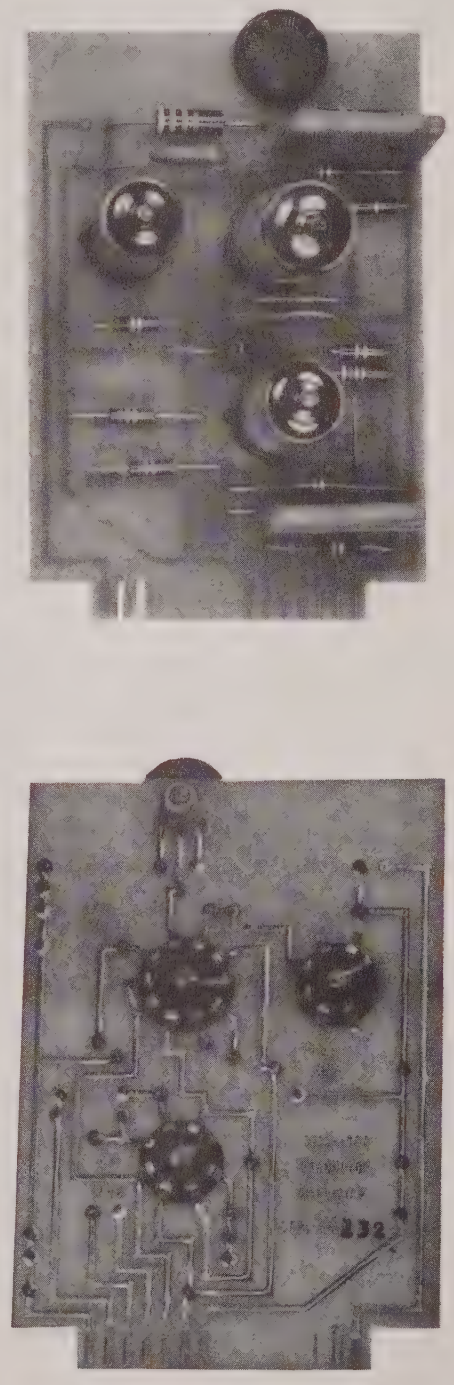


Figure 4. Regulator Amplifier 3033-10AA-2.

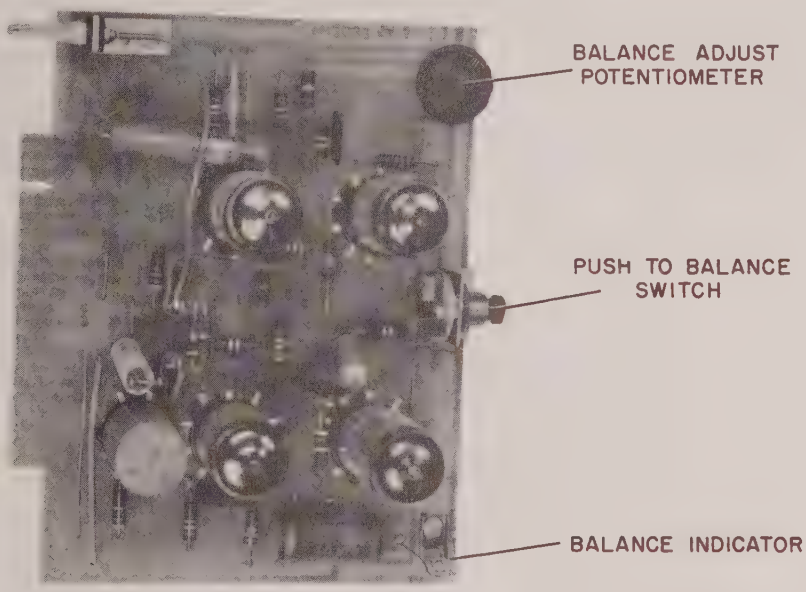


Figure 5. D-C Amplifier 3033-6A-3.

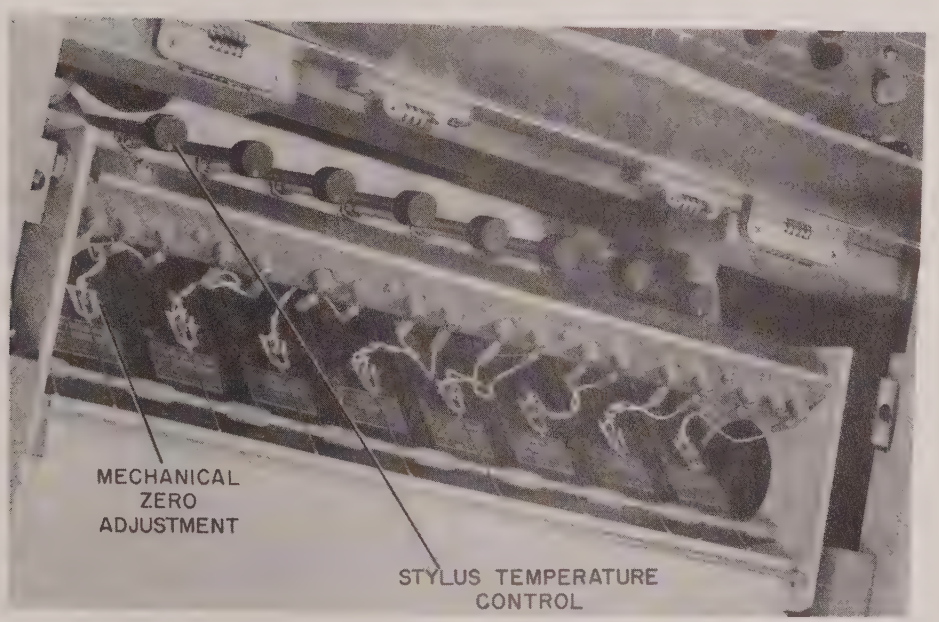


Figure 6. Recorder, top view showing pen motors.

TABLE IV

Control	Positions	Indicators	Function
POWER	OFF ON	RED	Controls application of primary power to Recorder.
COMPUTER CONTROL	RESET HOLD OPERATE		Controls mode of computer operation.
CALIBRATE	AUTO MANUAL	RED LAMP FOR EACH CALIBRATION VOLTAGE APPLIED	AUTO: Initiates one complete cycle of the Calibrate Unit. MANUAL: Causes calibrate unit to step *once*.
	LOCAL		LOCAL: Allows automatic calibrate cycle to be initiated *ONLY* by AUTO pushbutton.
	OFF		In this position, the calibrate circuits can not operate.
	REMOTE		In this position of the control, the automatic calibrate cycle can be started by operating the Remote Calibrate relay, *or* by depressing the AUTO pushbutton.
CHART SPEED			Eight positions provide a selection of chart speeds varying from 0.4 mm/sec. to 100 mm/sec.
RECORD	ZERO	AMBER	This position used for checking pens with zero signal input from calibrator.
	ON	WHITE	ON position connects signal inputs-disconnects calibrator; timer operates also.
	OFF		Chart drive stops; pen motors disconnected, timer off.
	REMOTE		Circuits prepared so that chart drive, pen motor relays, and timer can be energized by the Remote Control Relay.
PEN POSITION	- OFF + INCREASE		Two coaxial controls allow the operator to locate the no-signal position of the pen at any point from full scale left to full scale right. Switch (- OFF +) determines direction zero point is moved. INCREASE control is adjusted for desired position.
PEN POLARITY	+L OFF +R		A positive signal deflects pen to the left. No signal applied to pen motor. A positive signal delfects pen to right.
SENSITIVITY	8 POSITIONS EACH CHANNEL		Sensitivity varied in 8 steps from .05 volts/mm to 10V/mm.

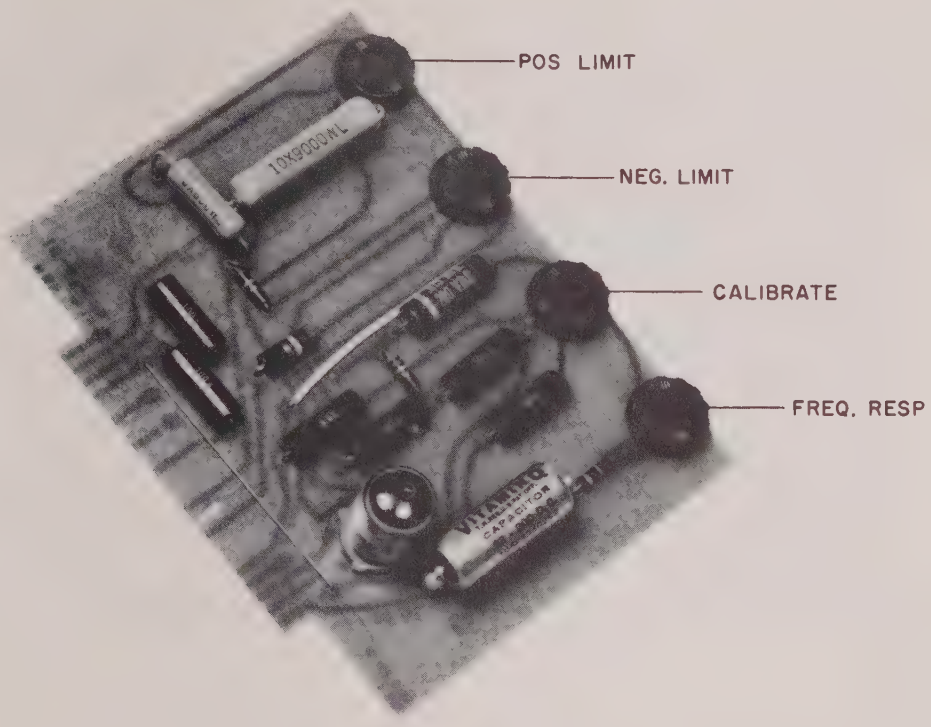


Figure 7. Network 12.091.

(3) Mechanical Zero. Turn the RECORD control to the ZERO position. Make sure each pen is tracing on the zero line. If not, use the zero adjustment screw on the pen motor to make adjustments.

(4) Pen Heat. Turn RECORD switch to ON and adjust the individual stylus temperature control of each channel. (See fig. 6).

(5) Positive and Negative Limits. With the sensitivity controls set at 0.1 volts/mm (± 2 volts full scale) connect a d-c input of 1 to 10 volts to all channels. If any pen goes off scale more than a millimeter or two, the limit control should be adjusted. Figure 7 shows the positive and negative limit controls. Now reverse the input voltage and adjust the other limit.

(6) Calibrate Potentiometers. Set the CALIBRATE switch to the LOCAL position. Depress the 0.1V/mm sensitivity pushbutton for each channel (± 2V full scale). Use the MAN pushbutton of the calibrate control to advance the Calibrate Unit to position 5. At this time all pens should be at full scale on the chart. If not, adjust the calibrate potentiometers on the networks. See figure 7.

(7) Frequency Response. Clockwise rotation of the Frequency Response potentiometer provides maximum response at the higher frequencies. Counterclockwise rotation provides minimum response. See figure 7 for location of this control.

3. OPERATION

a. General. After the adjustments described in the Installation section have been made, all control operations are performed at the Control Panel 20.050.

b. Control Panel 20.050. The controls and indicators located on the Control Panel 20.050 are shown in Table IV. (See fig. 8).

c. Independent Operation. To place the recorder in operation, set the controls as shown in Table II in the Installation section. Connect input voltages to terminals designated in Paragraph 2, subparagraph d *(1)*.

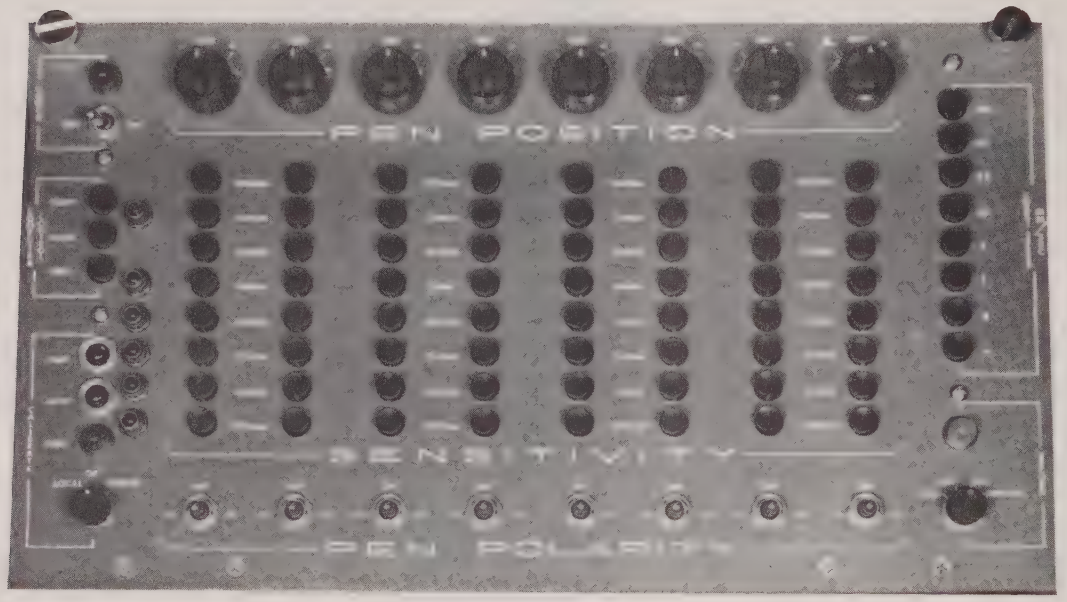


Figure 8. Control Panel 20.050.

(1) Turn power switch to ON position. Allow 60 seconds for warm up.

(2) Set the deflection sensitivity for each channel according to the input voltage.

(3) Set the PEN POLARITY switches as desired.

(4) Depress proper CHART SPEED switch for speed desired.

(5) Recording starts when the RECORD switch is turned to the ON position.

d. Operation with Computer. When the recorder is connected to a computer, the COMPUTER CONTROL switches (RESET, HOLD, OPERATE) can be used to control the mode of operation of the computer.

If the RECORD control is placed in the REMOTE position, the recorder is controlled by the computer mode control circuits. Thus, the recorder switches (RESET, HOLD, OPERATE) control the Computer Mode, and the computer turns the recorder on and off according to its mode of operation. Chart drive, pen motor relays, and timer are controlled by the computer.

e. Automatic Calibrate Unit Operation. When used with a 231R Computer, set the recorder CALIBRATE control in REMOTE; an automatic calibration cycle will be completed each time the computer goes from the Operate to the Hold mode.

f. Remote Operation. Place RECORD and CALIBRATE controls in REMOTE positions. Recorder will then be controlled from the remote point.

g. Zero Adjustment. Place the RECORD switch in the ZERO position and adjust the zero adjustment screws on the pen motors for proper zero position of the pens.

4. THEORY OF OPERATION

a. General. The Recorder Model 1902D plots eight variables simultaneously against time. Each channel is independent of others, but all are identical, so that a description of only one channel is given.

The input signal is applied to the d-c amplifier through the Calibrate Unit. The Sensitivity Switch, and the network input resistor. The amplifier output drives the pen motor. The various circuits will be described in the order in which they are encountered when tracing a signal through the channel from input to pen motor. See figure 9.

b. Calibrate Unit 48.002. (Refer to drawing D048 002 0S). The purpose of the Calibrate Unit is to provide a quick method of checking the deflection sensitivity of each channel. This is accomplished by selecting standard voltages from a precision voltage divider, and connecting them in sequence to all channel inputs simultaneously.

(1) Component Parts. The Calibrate Unit contains a stepper switch K1, and five relays K2 to K6. Their operation is controlled by switches on Control Panel 20.050. A brief description of these components and their functions is shown on the Function Chart.

(2) Operation. The Calibrate Unit operates as follows (refer to figure 10); assume the RECORD switch to be set at ON and the CALIBRATE control at LOCAL. The stepper switch K1 is in position 1. Note that capacitor C3 is charged through the CALIBRATE switch and MANUAL pushbutton. To start an automatic calibrate cycle the AUTO switch is depressed momentarily. Its contacts energize the Auto Relay K6, which energizes K2. Contacts 11 and 12 of K2 form a holding circuit for K6 so that these two relays remain operated after the AUTO pushbutton is released. Contacts 5 and 6 of K6 connect the charged capacitor, C3 across relay coil K5. K5 pulls in and its contacts 2 and 3 energize the master stepper coil (K1). The stepper moves to position 2. Capacitor C3 discharges through coil K5 and R12. When the voltage drops below the value required to hold in the relay, K5 drops out and also K1. The interrupter contacts of K1 now re-charge the capacitor through K1d and contacts 2 and 3 of K6. The process is continuous until the stepper again reaches position 1 when the charge path is broken. Adjustment of R14 changes the time constant of the circuit and regulates the speed of the stepping action.

At position 1, the stepping action stops, as mentioned above, and the circuit for K2 is broken through K1e; its holding contacts 11 and 12 release the Auto Relay. The Calibrate Unit remains at this position until another cycle is initiated, or a manual step accomplished.

K1f closes when the stepper moves to position 2 (it is closed for all positions except 1). The two sections of K1f operate relays K3 and K4, the Signal Input relays which connect the calibrated voltages to the channel inputs.

(3) Manual Operation. The Calibrate Unit can be moved one step at a time using the MANUAL pushbutton. As shown in figure 10, Capacitor C3 is charged through this pushbutton; when it is depressed, C3 is connected across relay coil K5 and one step is accomplished. The action is not repetitive because the Auto Relay is not energized. In order to make the calibrate unit step again, the MANUAL pushbutton must be released and then depressed again.

(4) Chart Speed Control. During a cycle of the Calibrate Unit, the chart speed is automatically adjusted to 20 mm/sec by the operation of relay K2. Contacts 4 and 5 enersize the ÷5 solenoid of the speed control; contacts 7 and 8 disable the ÷2 solenoid, and contacts 9 and 10 disable the ÷25 solenoid. During manual advance of the Calibrate Unit, the chart speed is determined by the Control Panel settings because the Auto Relay is not energized.

(5) Stylus Temperature Control. During a calibrate cycle, the stylus temperature is automatically set at the high level because of the rapid chart speed. This is accomplished by contacts 2 and 3 of relay K2. The circuits are shown in figure 11, Stylus Temperature Control Circuits.

(6) Zero Adjust. Zero adjustment of the pens is accomplished by placing the RECORD switch in the ZERO position (see fig. 12). This action turns on the Chart Drive motor, operates the Pen Motor Relays, and energizes the Signal Input Relays K3 and K4. Since the stepper, K1, is in position 1, a zero calibrate signal is transmitted to all channels.

c. Sensitivity Switch. (See drawing D020 050 0S). One of these switches Controls the deflection sensitivity of each channel. Depressing one of the eight pushbuttons on the Control Panel selects deflection sensitivities as shown in Table V.

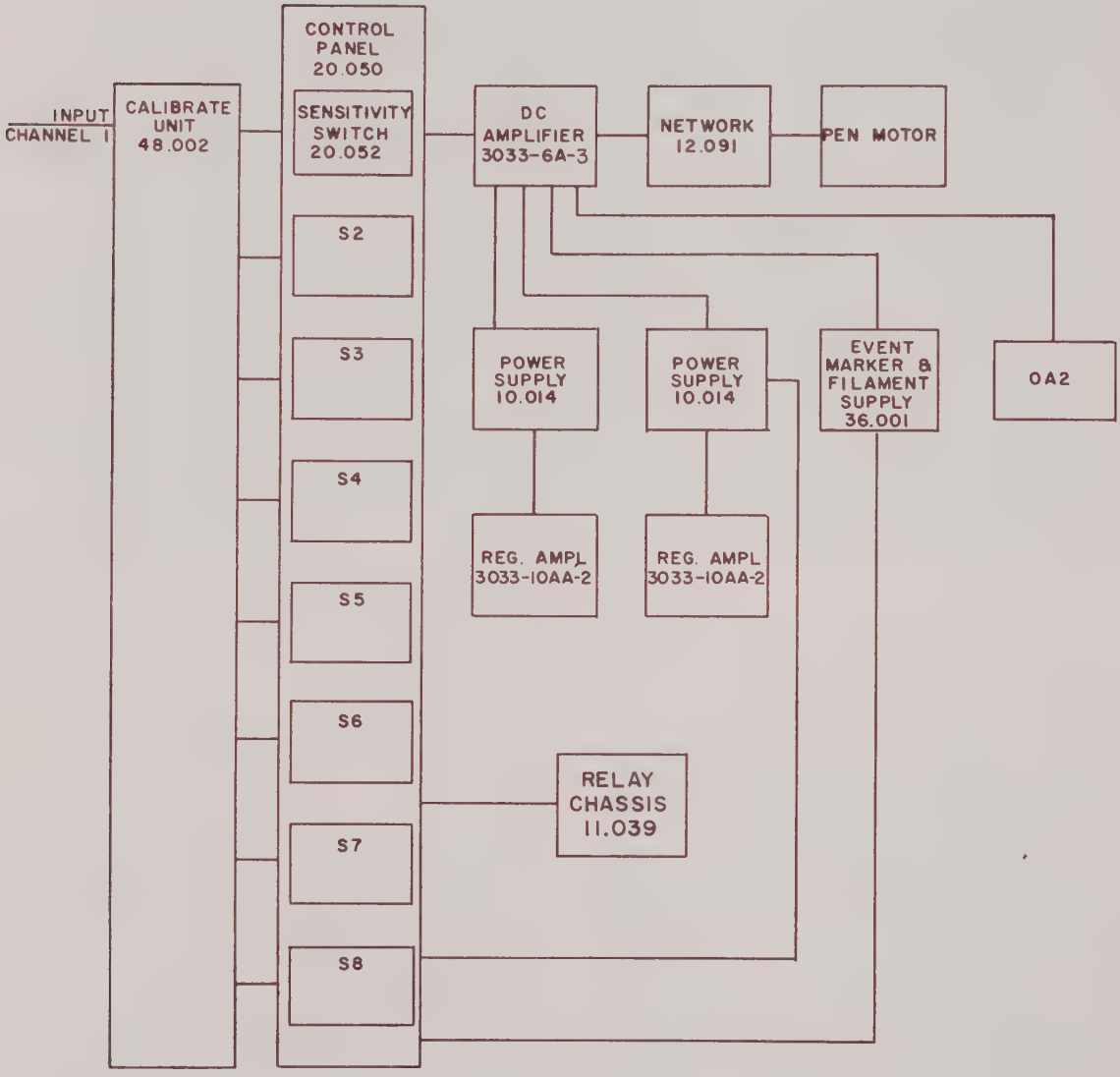


Figure 9. Recorder 1902D, Block Diagram.

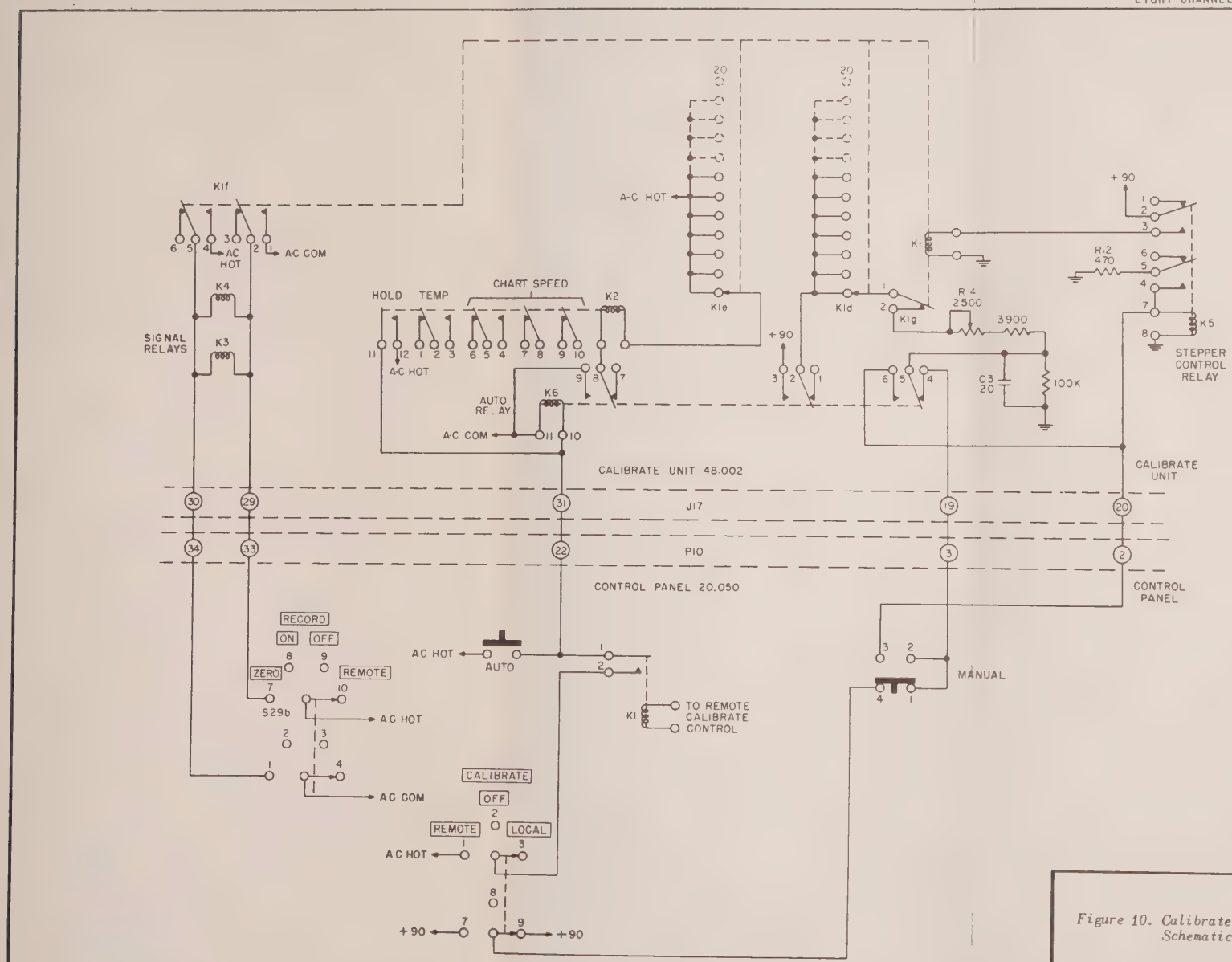


Figure 10. Calibrate Unit, Simplified Schematic.

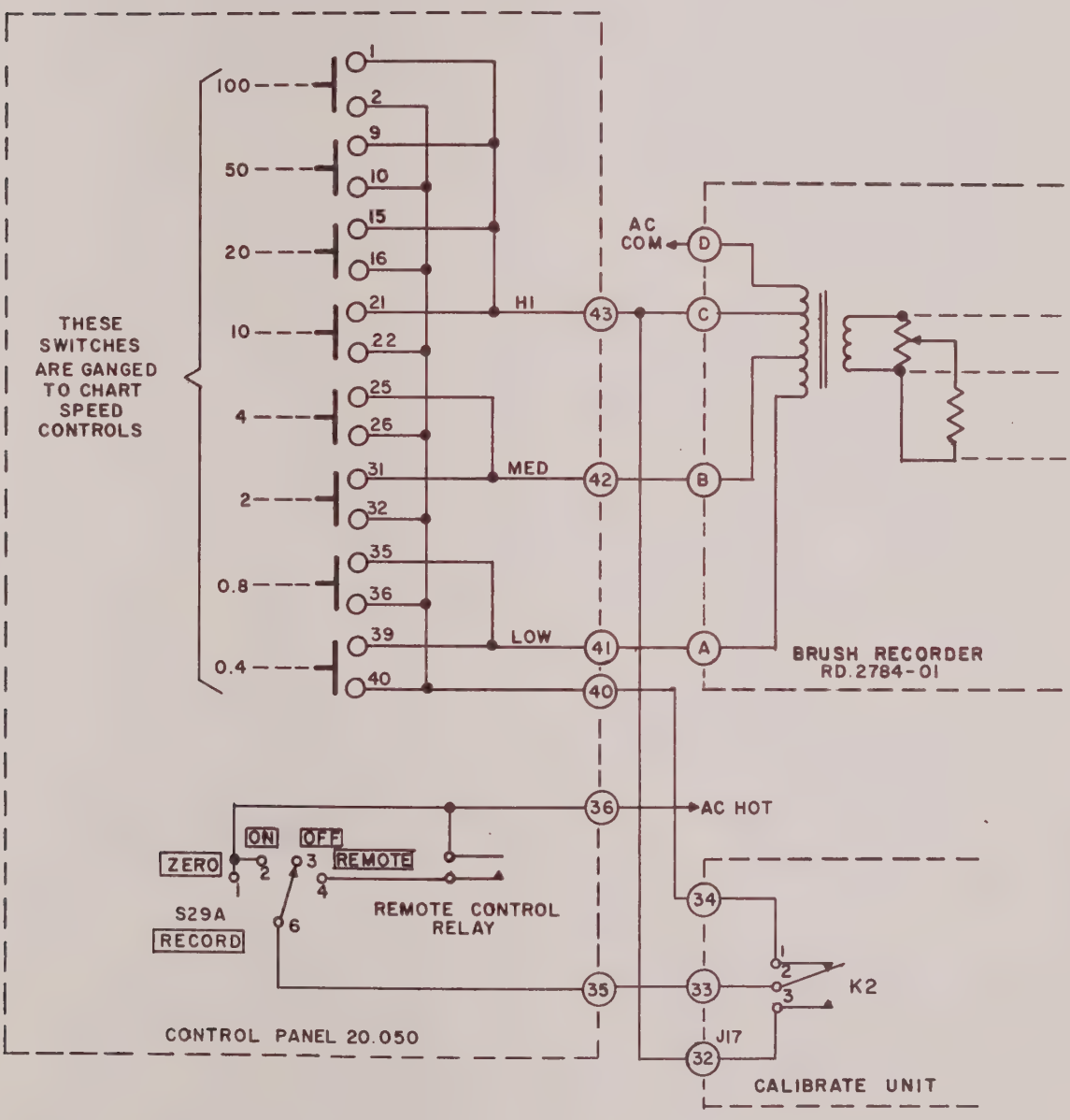


Figure 11. Stylus temperature Control Circuits.

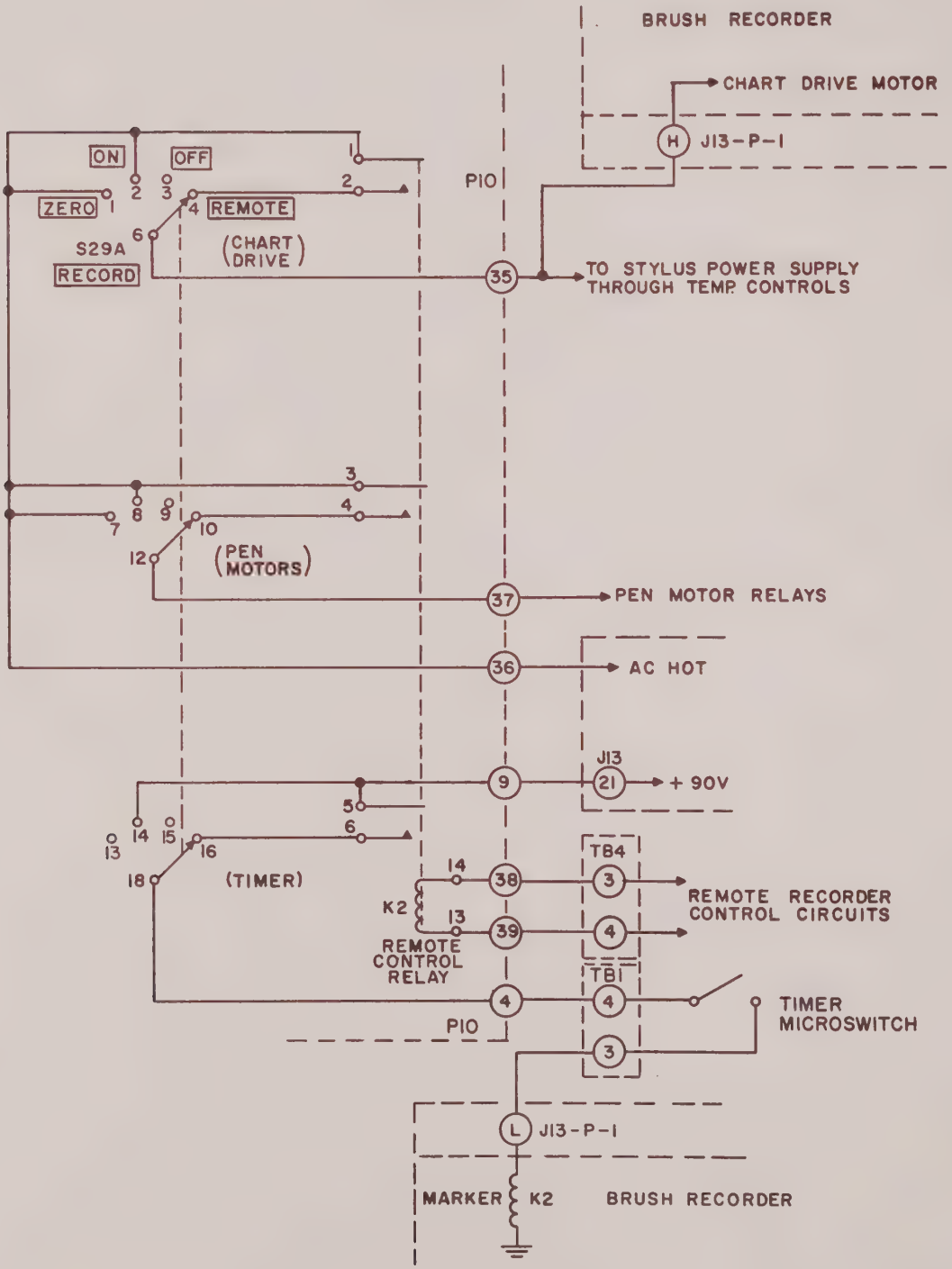


Figure 12. Remote Control Circuits for Chart Drive, Pen Motors and Timer.

FUNCTION CHART

DESCRIPTION	FUNCTION
K1 Stepper Switch; 5 levels (a-e) of 29 positions each; K1f, two sets of form "A" contacts; K1g, form B interrupter.	Level a operates the indicator lights on the Control Panel which show the calibrating voltage applied. Level b connects either + or - 100 Volts reference to the top of the precision voltage divider. Level c selects a tap on the voltage divider. The voltage at the tap is used for calibrating pen sensitivity. Level d operates in conjunction with K1g (interrupter) to provide continuous stepping action throughout the calibrate cycle. Level e operates relay K2 during the calibrate cycle. Section K1f operates the Signal Relays K3 and K4 during the calibrate cycle. Section K1g is the interrupter which allows sequential stepping of the unit.
K2 5 - pole, 2 - position relay	First section adjusts stylus temperature during calibrate cycle. Second, third, and fourth sections adjust chart speed during calibrate cycle. Fifth section provides holding contacts for K6.
K3, K4 Signal Input Relays, each are 4 - pole, 2 - position	These relays remove the d-c amplifier inputs for each channel from the signal source, and connects them to the calibrate voltage.
K5 Stepper Control Relay 2 - pole, 2 - position	First section of this relay applies 90 volts to the stepper relay K1. Each time K5 is energized, it operates the stepper. Second section discharges capacitor through 470 ohm resistor.
K6 Auto Relay 3 - pole, 3 - position relay	This relay must be energized for automatic operation of the Calibrate Unit. First two sections are used to charge capacitor C3 and to connect it to the coil of K5. The third section operates relay K2.

TABLE V	
0.05	Volts per millimeter
0.1	Volts per millimeter
0.2	Volts per millimeter
0.5	Volts per millimeter
1	Volt per millimeter
4	Volts per millimeter
5	Volts per millimeter
10	Volts per millimeter

The various sensitivities are obtained by changing the gain of the d-c amplifier. When the switch is set for maximum sensitivity of 0.05 volts per millimeter, the input and output terminals of the switch are shorted. As shown in figure 13a, the gain is 33.3. In succeeding positions requiring reduced sensitivity resistors are added to the input resistor, decreasing the gain of the amplifier. At the 1 volt per millimeter position of the switch a divider is added at the input which further reduces the over-all gain. To illustrate how the gain is calculated, the 2-volts-per-millimeter switch position is shown in figure 13b. Full scale deflection on the chart is ±20 millimeters. Therefore full scale voltage deflection for this sensitivity is ±40 volts. The pen motor alone requires about 33 volts for full scale deflection, so an attenuator is required. The resistor R6 is effectively in parallel with R2 and R3 in the Sensitivity Switch, and with R2 in the network, because the summing point 0 is at zero potential. Therefore, the effective value of R6 is equal to

$$\frac{R6\ (R2 + R3 + R2)}{R6 + R2 + R3 + R2} \quad \text{or } 66.66K.$$

The voltage E1 at the junction of R1 and R2 can be determined using the effective value of R6. E1 is equal to 4 volts. The input resistor of the amplifier is composed of R2 and R3 in the Sensitivity Switch and R2 in the network for a total of 400,000 ohms. Combined with the 1-megohm feedback resistor, this network produces a gain equal to

$$\frac{R_{FB}}{Rin} \quad \text{or } 2.5.$$

Since the feedback resistor is connected to a voltage divider at the amplifier output, at a point 1/3 of the distance from ground, this connection provides a gain of 3.3. Total gain is equal to 2.5 x 3.3. Output of the amplifier is:

$$E_o = E_1 \times 2.5 \times 3.3$$

$$E_o = 4 \times 2.5 \times 3.3$$

$$E_o = 33.3 \text{ volts}$$

d. Network 12.091. Refer to schematic drawing B012 091 0S and figure 15. Input, summing point, and output of each amplifier are brought to terminals on the Amphenol jacks on the Equipment Mounting Plate in which the networks are installed. The printed circuit networks 12.091 contain the following components:

Input Resistor
Feedback Resistor Network
Load Resistors
Negative and Positive Limiting Diodes
Frequency Response Control Circuit
Pen Position Isolating Resistor

(1) The input resistor is R2 which is connected to the output of the Sensitivity Switch when the network is plugged in.

(2) R3, R5, Calibrate Control R4, R6, and R14 comprise the feedback network. The principle feedback resistors R6 and R14 (1 meg) in conjunction with input resistor R2 (100K) would provide a gain of 10 if connected directly to the output of the amplifier, one volt at the input producing 10 volts at point 0, figure 16. However, the feedback resistor is terminated at a point on the divider R3, R4, R5, at which only 1/3 of the output voltage is available for feedback. Therefore, in order to satisfy the condition of zero voltage at the summing point S, the voltage at 0 must rise to 33.3. The network thus provides a gain of 33.3.

(3) The load resistor for the amplifier is composed of R11, R12, and R13, totaling 10,050 ohms. In parallel with this load is that of the pen motor and its series resistor, the two of which total 1400 ohms.

The load seen by the amplifier is that of the two in parallel, - about 1260 ohms.

(4) The limiting diodes restrict the excursion of the pen to 20 millimeters on each side of center so that a large voltage input will not damage the pens or cause them

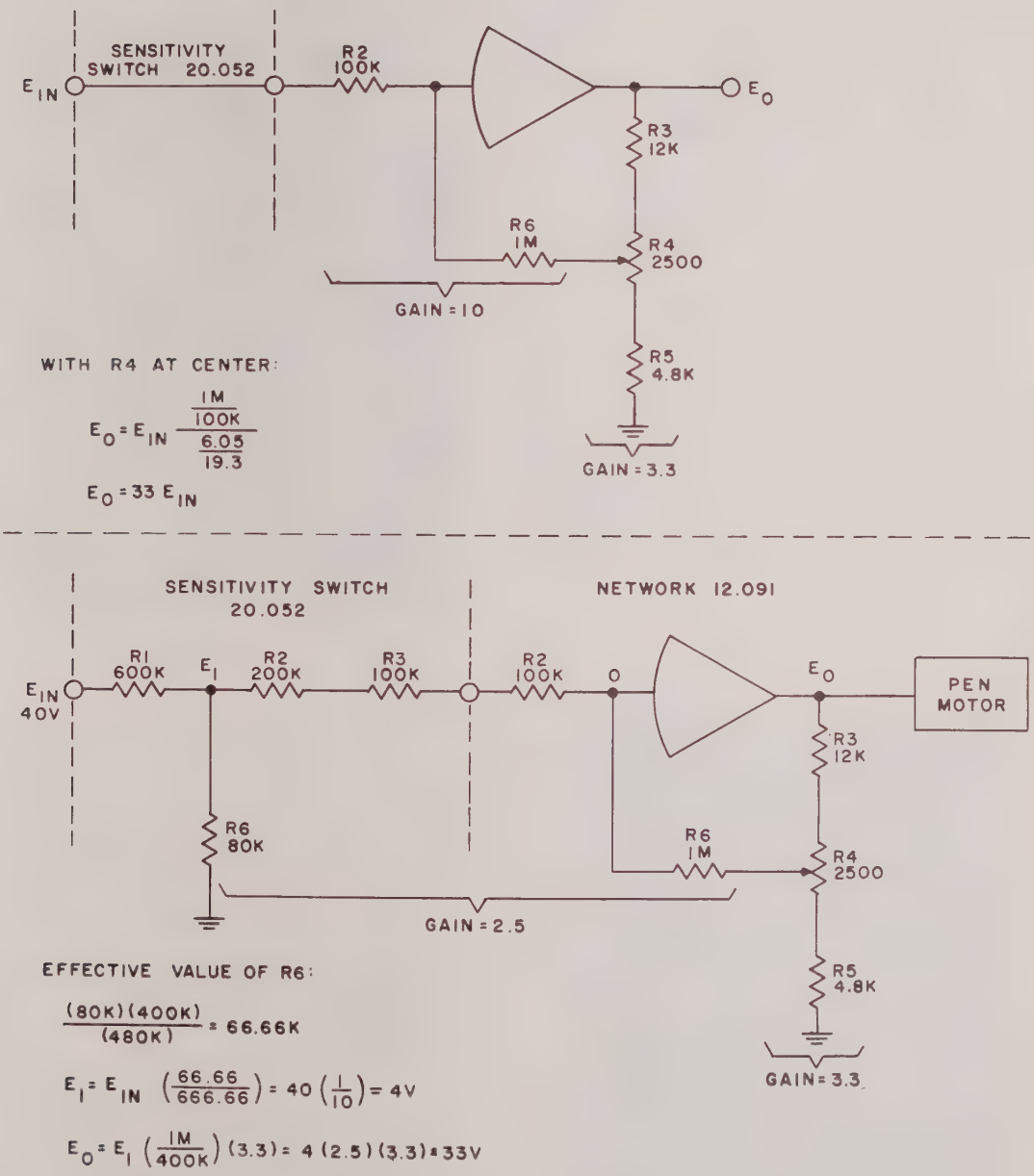


Figure 13. Sensitivity Switch, Simplified Schematic.

to jump out of their holders. ±20 millimeters represents ±33 volts at the output of the amplifier. Each diode is connected across the amplifier to a point on a voltage divider. R9 and R12 adjust the negative and positive limits respectively. If more than +33 volts appears at the output, about 330 volts drop will be present across the divider R11, R12, R13. In this condition, the plate of D1 becomes slightly positive and the diode conducts. This, in effect, places a very small feedback resistor across the amplifier, reducing its gain to a very low value. The negative limit operates in the same manner, effectively limiting the amplifier to an output of -33 volts.

(5) The Frequency Response control consists of the capacitor C1 (0.5 μf) and the potentiometer R7. This two section network compensates for the roll-off of the pen motor to make the response essentially flat to 40 cps, and 3 db down between 60 and 70 cps. The control allows adjustment to compensate for differences in the resonant frequencies of individual pen motors. Figure 3 shows the attenuation curve for two settings of the potentiometer.

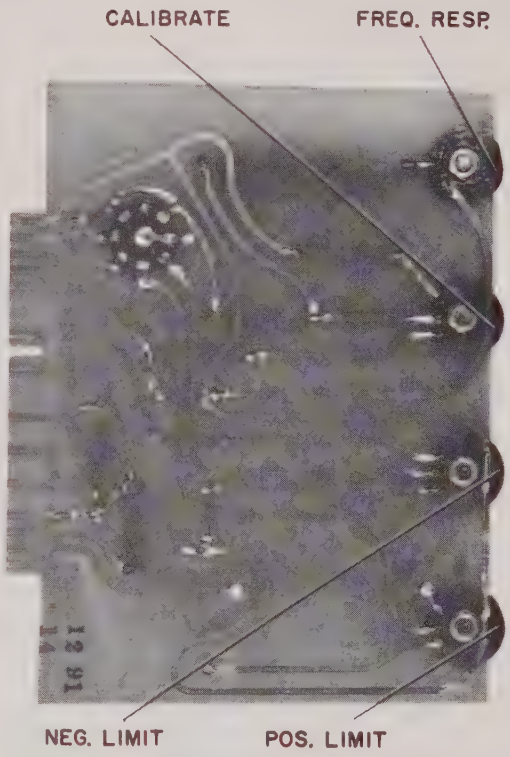


Figure 15. Network 12.091, bottom view

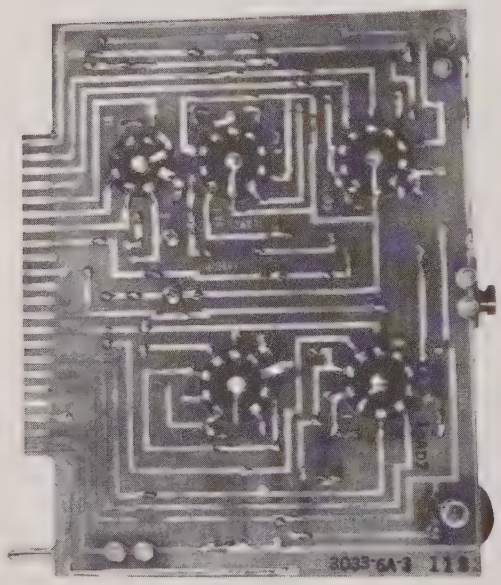


Figure 14. D.C. Amplifier 3033-6A-3, bottom view.

(6) R2 (100K) is an isolating resistor between the summing point and the pen-position voltage.

e. D.C. amplifier 3033-6A-3. All of the d.c. amplifiers are identical. Refer to schematic diagram C3033S6A3 during this discussion (See also fig. 14).

The d.c. amplifier can be divided into three parts: *(1)* voltage amplifier, *(2)* cathode follower, and *(3)* stabilizer.

(1) The voltage amplifier consists of V1a, V2a and V2b. The input signal is directly coupled to the grid of V1a. Cathode bias is used in this stage. The plate of V1a is coupled to grid V2a by a 680K resistor, R5. The plate of V2a is connected to grid V2b through R10 (1.6 meg). Thus V1a, V2a, and V2b comprise a three stage direct-coupled voltage amplifier.

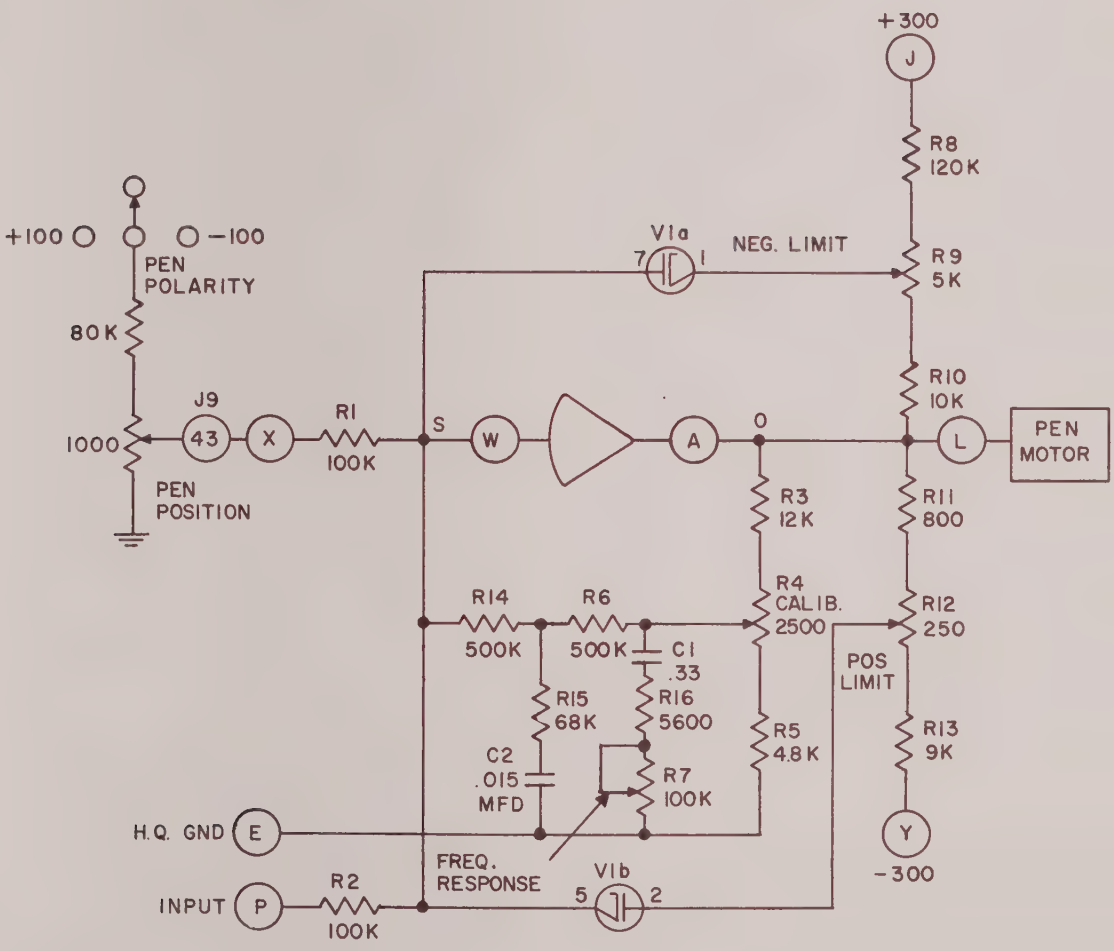


Figure 16. Network 12.091, Simplified Schematic

The reference level at the grids of V2a and V2b is held down by the use of the summing networks R5, R7, R8 and R10, R11 respectively. These networks add a negative bias voltage (-300) to the voltage at the plates of the preceding tubes. The gain of this section is about 30,000.

(2) The plate of V2b is directly coupled to the control grid of V3, the cathode follower. The load resistor for the amplifier is composed of R12, R13 and R14 in the network (schematic diagram B1902S12A) totaling 13,050 ohms. The 3000 ohm resistor, R13, in the plate circuit of this tube is a current limiting resistor which prevents the 5763 from exceeding its maximum plate dissipation.

(3) The stabilizer portion consists of the chopper D1, a two stage amplifier V4 and a low-pass filter R22, C6.

Assume a positive drift voltage at the grid of V1 pin 7. This voltage is coupled by resistor R14 to chopper pin No. 1. This point is grounded during one half the cycle of the chopper making the voltage at C2 zero. During the ungrounded portion of the cycle, the drift voltage appears at C2 in the form of a square wave, which is coupled to the grid of V4a by C2 and R23-a grid limiting resistor-and amplified by the two triode sections in series. The amplified square wave appears at the junction of C5 and R21. A neon bulb, I1, is connected between this point and ground to serve as an overload indicator.

The junction of R21 and R22 is connected to the other chopper pin No. 6. The operation of the chopper is such that when the input is grounded the output is ungrounded, and vice versa. The purpose of this second chopper connection is to establish the zero reference level-and therefore the polarity-of the output voltage. Instead of the a.c. square wave at pin 6 of V4, a pulsating negative d-c appears at the junction R21, R22. This signal is filtered by R22 and C6 so that only the d-c component is impressed on the grid of V1b.

Thus far it has been shown that a positive drift voltage at the amplifier input produces a negative correction voltage at the stabilizer output. This negative voltage is applied to the second section of V1 causing it to draw less current through its cathode resistor, R2. Since the cathodes of V1a and V8b are tied together, this is the same as introducing a negative signal at the cathode of the first section. A negative signal at this point produces a negative output from the amplifier which, when fed back through the external feedback resistor, cancels the positive drift.

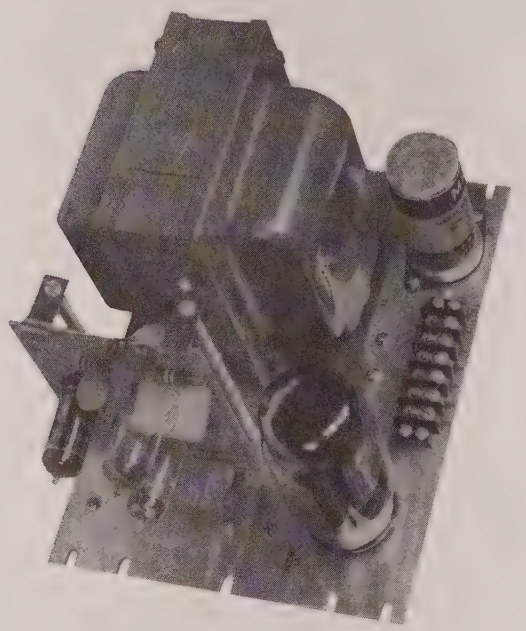
S1 grounds the output of the stabilizer. To balance the amplifier press down S1, the push-to-balance switch, and adjust the balance adjust potentiometer R8 until the neon balance indicator goes out. This indicates that there is no output from the stabilizer, no input, and no voltage at the amplifier input. When the switch is released, the stabilizer is reactivated. R6 and C1 in the amplifier, and R15 and C3 in the stabilizer, are high frequency cutoff networks.

f. Power Supplies.

(1) Regulated Power Supply Model 10.014 is shown in figure 17. Figure 18 is a simplified schematic of this power supply and Regulator Amplifier 3033-10AA-2. The latter is a printed circuit unit which is plugged into connector J1 on the power supply chassis. The type 6336 regulator tube is in series with the load, acting as a variable resistance the value of which is controlled by the voltage on the grids. When the output voltage goes up, the regulator grids become more negative increasing their resistance and reducing the output voltage.

V1 and V2 form a three-stage d-c amplifier. The circuit functions as follows. Assume the output of the supply drops below normal, because of increased load. The voltage divider R2, R7, R10 is connected across the output (TB1-4, TB1-5). In the +300 volt supply, the low side (terminal 4) is grounded, and the high side (terminal 5) is at +300 volts. The arm of R10 is connected directly to the grid of V2b. The negative change in the output voltage is coupled to the grid, amplified, and transmitted to the cathode follower V2a where it appears at the Cathode as a positive signal. Here it is directly coupled to the Cathode of V1 causing the V1 plate to go more positive. The positive voltage coupled to the regulator grid by R2 reduces the internal resistance of the tube, and the voltage drop across it. The output of the supply rises.

Capacitor C1 is a direct low impedance coupling for high frequency transients to the grid of V2b. C2 performs the same function at the grid of V1.



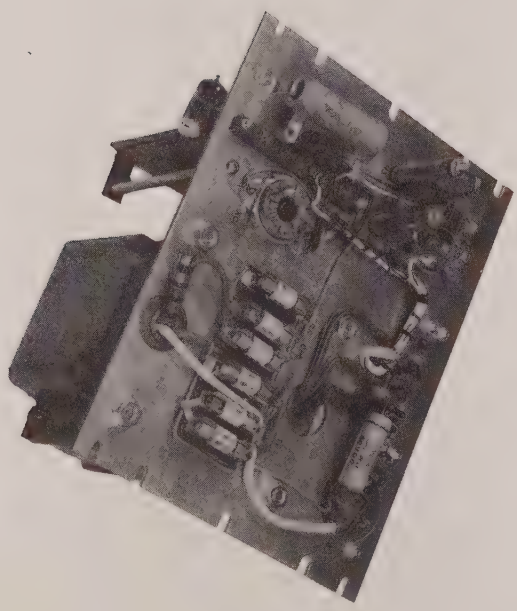


Figure 17. Power Supply 10.014

The voltage divider R3, R8 holds the grid of V1 at approximately 135 volts, and couples to it any change in the output.

The 330K resistor R11 provides firing voltage for V3 regardless of the setting of R10 (voltage adjust), and provides a constant load for the regulator. C3 is the normal cathode bypass.

g. Control Panel (Schematic D020 050 0S).

(1) The POWER switch opens both sides of the a-c line in the OFF position.

(2) The operation of the SENSITIVITY switches (S1-S8) is described in Paragraph 4, sub-paragraph **c.**, above.

(3) The CHART SPEED switch (S30) controls the eight-speed transmission in the Brush Recorder by energizing the speed control solenoids in various combinations (see fig. 19). The solenoids are marked ÷2, ÷5, and ÷25. With none of the solenoids energized, the transmission runs at full speed, 100 millimeters per second. When ÷2 solenoid is energized, the speed is divided by 2, 50 millimeters per second. Energizing the ÷2 and ÷5 solenoids divides the speed by 10 producing a speed of 10 millimeters per second.

When one of the pushbuttons of switch S30 is depressed, the switch associated with that pushbutton is opened. The 4, 20, 50, and 100 positions have two or more switch sections ganged. Table VI shows which solenoids are energized for each speed.

TABLE VI

Speed	Solenoids Energized		
0.4 mm/sec.	÷2	÷5	÷25
0.8		÷5	÷25
2	÷2		÷25
4			÷25
10	÷2	÷5	
20		÷5	
50	÷2		
100			

The Chart Speed switch has another set of closures, one for each speed or a total of eight. These are shown in figure 11. They are used to adjust stylus temperature to an appropriate heat for the chart speed in use. Three temperature settings are available; they have

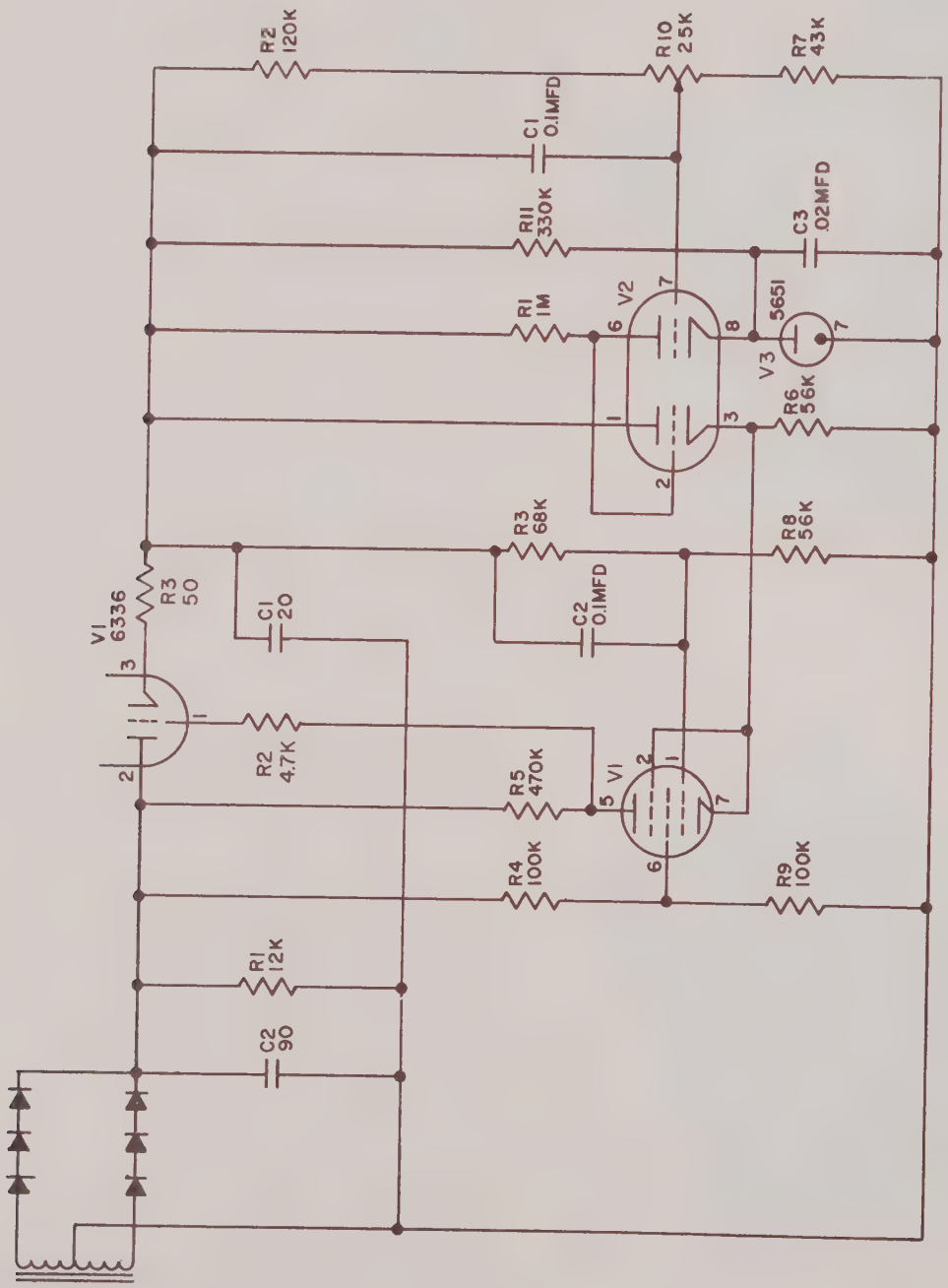


Figure 18. Power Supply and Regulator Amplifier, Simplified Schematic.

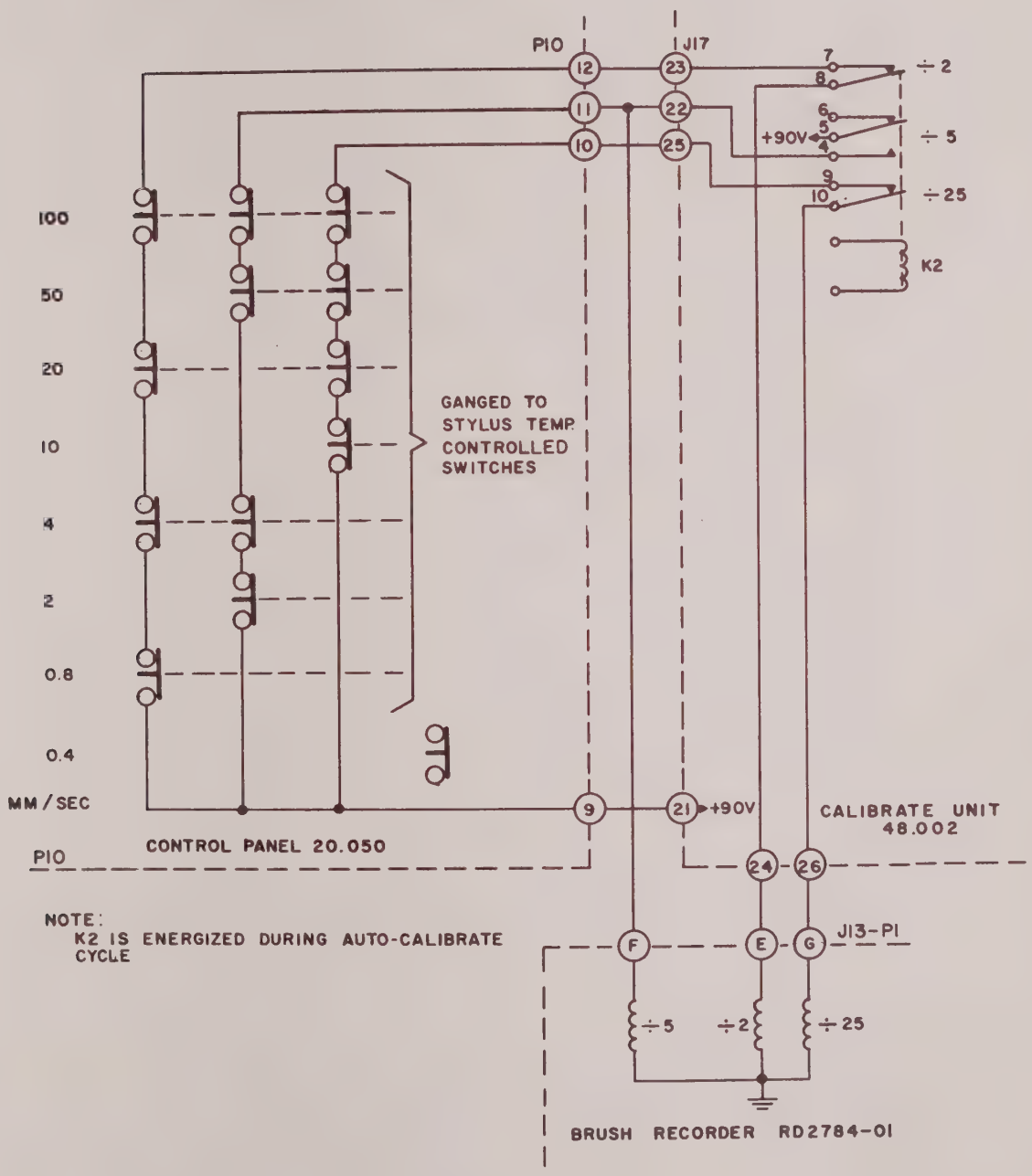


Figure 19. Chart Speed Control.

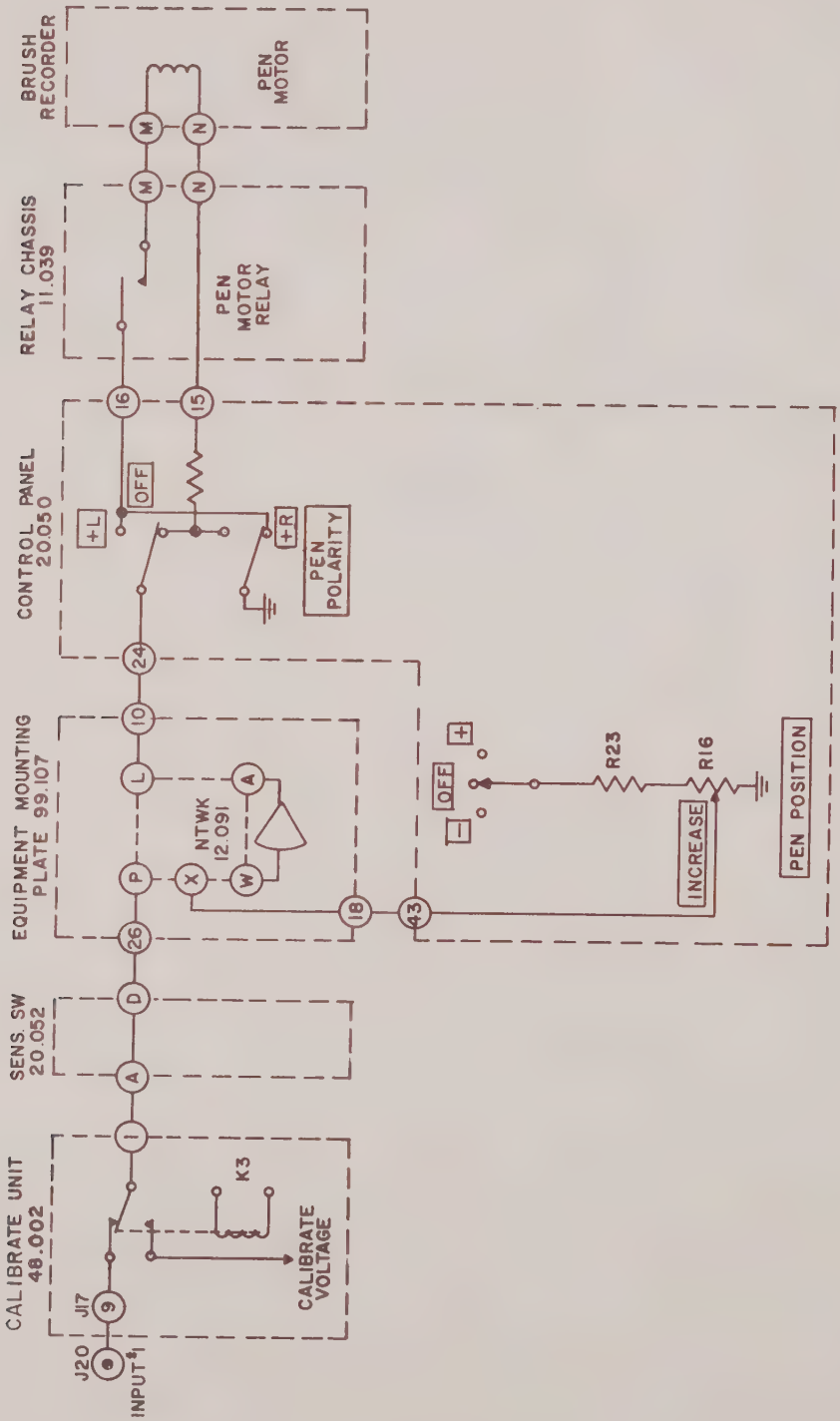
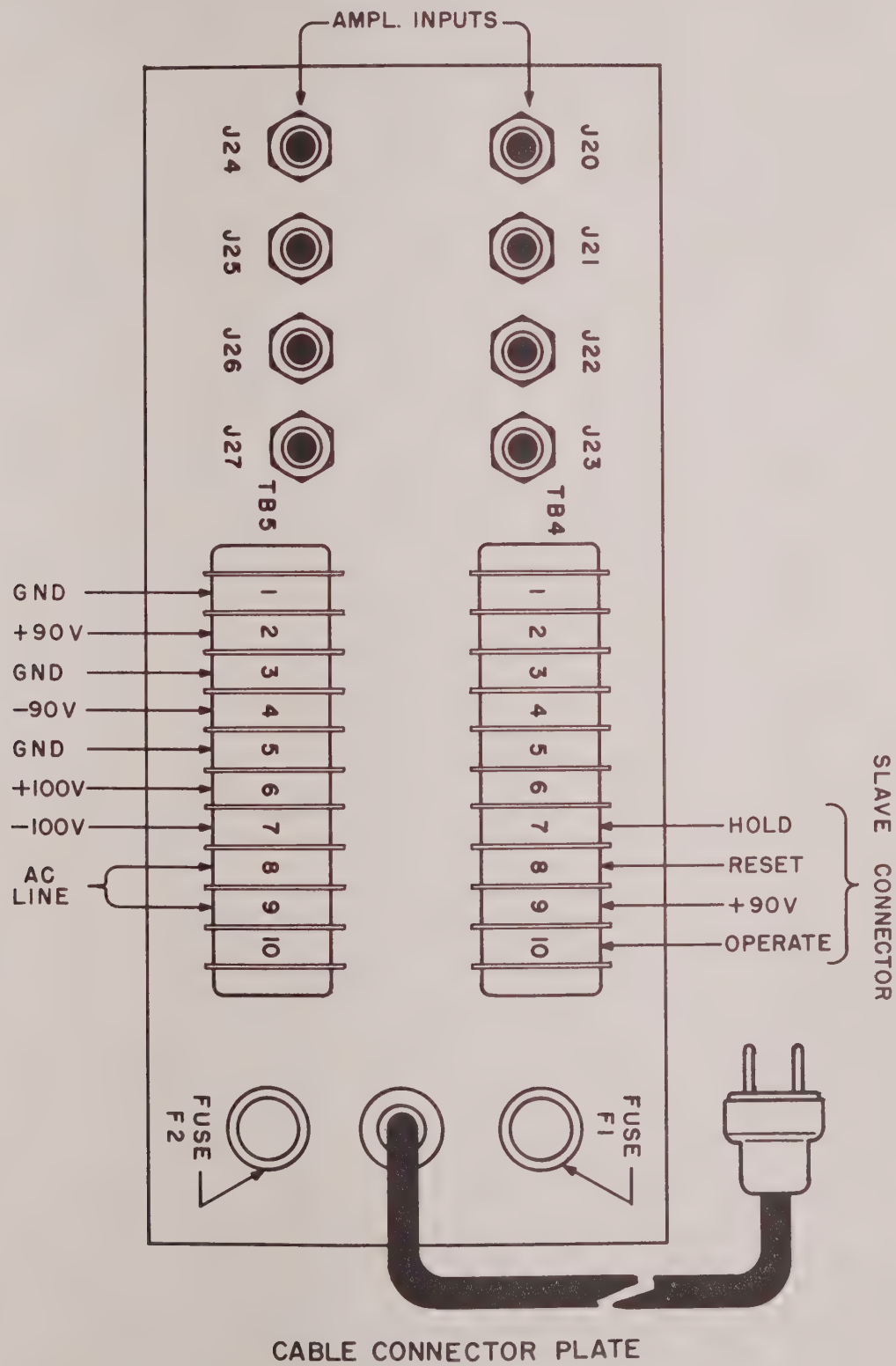
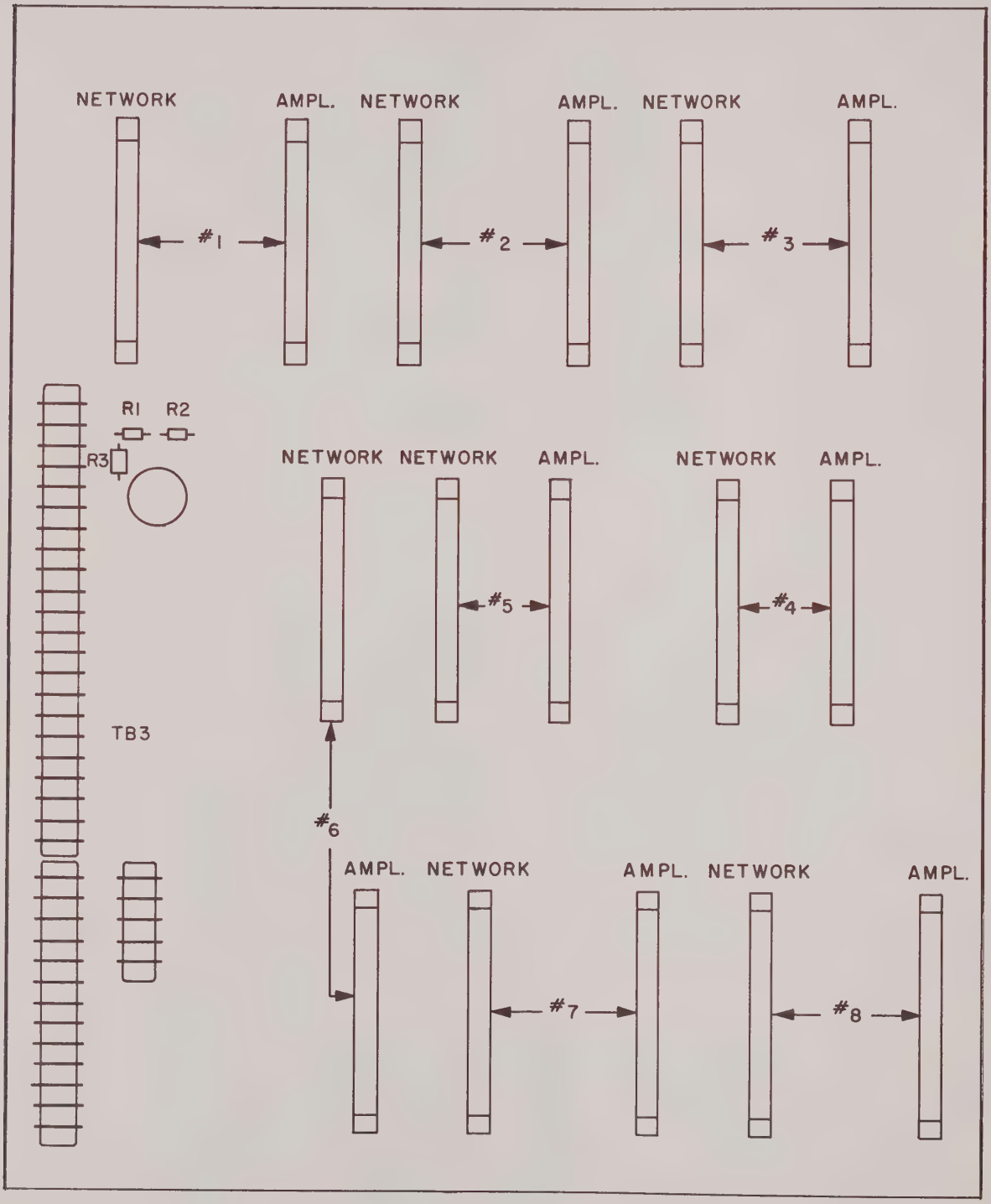


Figure 20. Recorder, Block Diagram - Signal.



CABLE CONNECTOR PLATE



EQUIPMENT MOUNTING PLATE

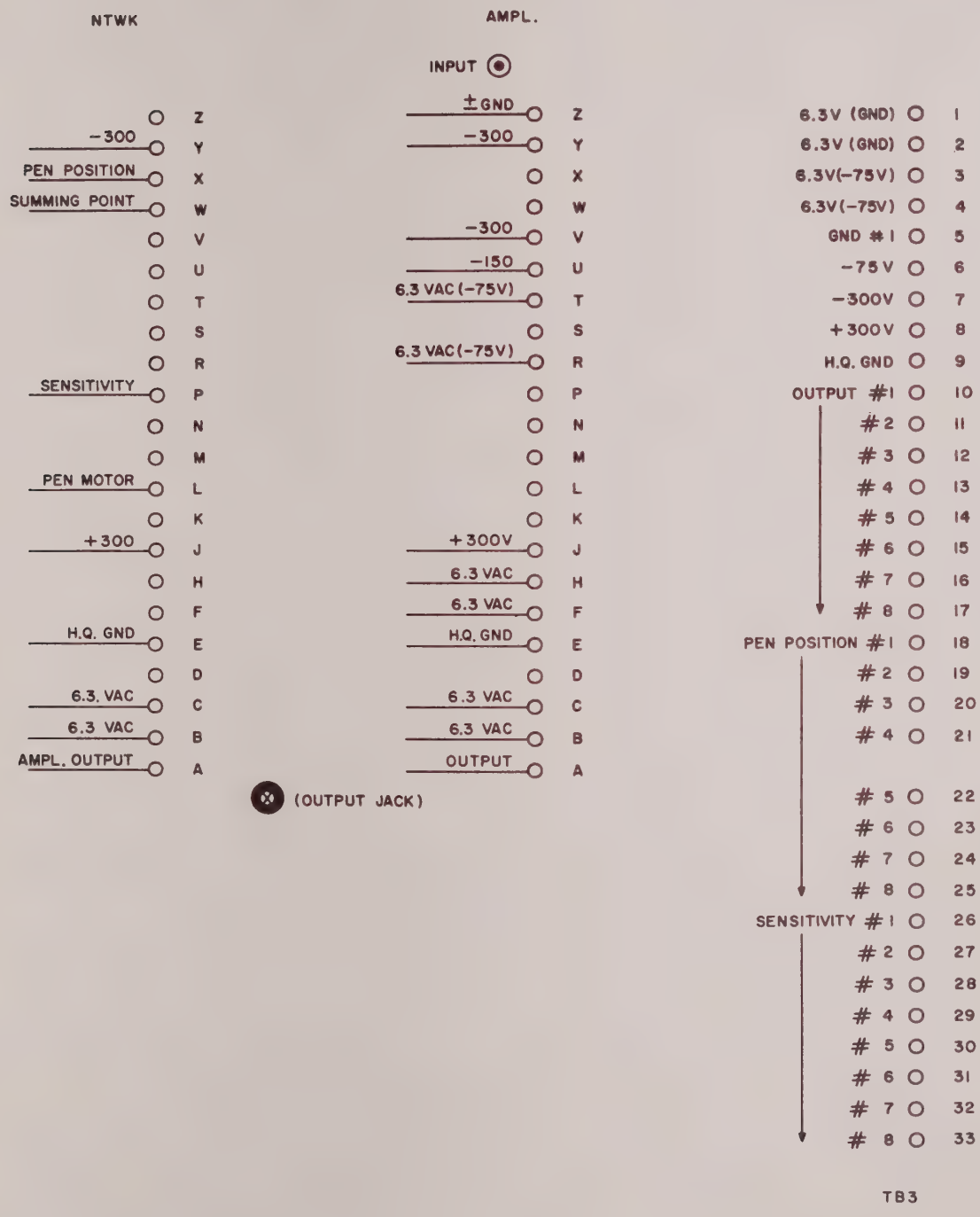


Figure 21. Equipment Mounting Plate.

been designated Hi., Med., and Low in the figure. The three different temperatures are obtained by selecting taps on the primary of the transformer.

(4) The PEN POSITION controls S9 through S16, and R9 through R16, are mounted coaxially with the switch controlled by the outside knob. The arm of the switch is connected in series with an 80,000 ohm resistor and the INCREASE potentiometer to ground. The voltage across the pot is about 1.2 volts, plus or minus depending upon the position of the switch. The arm of the potentiometer is connected to the amplifier input through the 100K resistor which, in combination with the feedback network, produces a gain of 33.

(5) The PEN POLARITY switches (S17 through S24) are three-position, two-pole units. The amplifier output is connected to one switch motor and the other is grounded. As shown in figure 20, the +L and +R positions of the switch reverse the connections to the pen motor.

(6) The RECORD switch has five sections. The two at the top of the schematic (D020 050 0S) apply 115V a-c to the Signal Input Relays, K3 and K4, when the switch is in the ZERO position. These relays must be energized when the Calibrate Unit is in use. As shown in figure 11, the switch controls are bridged by contacts of K1f, a section of the stepper switch in the Calibrate Unit. K1f closes the circuit whenever the Calibrate Unit is in operation.

The lower three sections of the Record switch are shown in figure 12. The upper two sections control Chart Drive stylus temperature and Pen Motor Relays by connecting the hot side of the a-c line to them in the first two positions, ZERO and ON. In the REMOTE position the switch contacts are placed in series with contacts of the Remote Relay K2.

The bottom section of the switch controls the operation of the Timer, which requires 90 volts for the marker pen motor. In this circuit, the switch and relay contacts are in series with the cam-operated Microswitch in the Timer.

(7) The operation of the Calibrate controls are explained in Paragraph 4, subparagraph b.

h. Event Marker and Filament Supply 36.001. This unit contains two filament transformers T1 and T2, and the Brush Timer Kit BL989F. T1 delivers 6.3 volts at 20 amperes for filament power; T2 delivers 6.3 volts at 6 amperes for filament power. The timer motor runs whenever the Power switch is turned on. It makes a switch closure once each second which is used to operate the event marker pen.

5. MAINTENANCE

For maintenance information on the Brush recorder #RD2784-01, reference should be made to the instruction book of that name supplied with the equipment.

Stylus pressure should be checked periodically using the stylus pressure gauge supplied. Pressure should be held between 1/2 and 3/4 grams. Adjustment of stylus pressure is accomplished by slightly bending the shaft of the stylus with the special tool supplied (see Brush Instruction Manual, page 2). Removal or installation of styluses is accomplished by using the special tool mentioned above.

If the styluses skip, or the line weight varies, crocus cloth should be placed beneath the point on the chart paper; a small 60-cycle voltage applied to the input of the channel causes a buffing action to occur.

When the air filter becomes clogged with dust, it should be changed. The paper drawer is removed to allow replacement of the filter. New filters may be obtained from Electronic Associates; the part number is C254 002 0.

To aid in trouble shooting, figure 21 shows the terminals on the equipment mounting plate and the functions of each. Amplifier and network connections are shown also.

6. PARTS LIST

a. 8 Channel Recorder 1902D (99.003)

Reference Symbol	Description
	Assembly; control panel 20.050
	Assembly; calibrate unit 48.002
	Assembly; Reg. Power Supply, 10.014 300V 500 MA

Reference Symbol	Description
	Assembly; 1 sec. event marker and fil. supply 036.001
	Assembly; relay chassis 11.039
	8 Channel Rectilinear Oscillograph, Brush Co. #RD2784-01

b. Control Panel 20.050

Reference Symbol	Description
CR1, CR2, CR3, CR4	Rectifier, Selenium, Federal #8A5PS5
I1, I2, I3	Lamp; Neon #GE-NE-2D
I4 through I9	Lamp; Incandescent, GE #328
K1	Relay; 115V AC, 1 form A Leach type 7-a
K2	Relay; 115V AC, 3 form A Leach type 7-3-a
P9, P10	Connector Receptacle: Cannon #DPD-45-34P-1L
R8, R17 through R23	Resistor; 80,000 ohms ±1%, Weston Vamistor type 9851
R9 through R16, S9 through S16	Combination rotary switch and model 2 control, miniature type, Centralab series PA033; control resistance 1000 ohms; C1 taper switch 3 poles, 2 to 3 pos., PA020, shaft length-outer shaft 5/8, inner shaft to extend 5/16 from outer shaft Centralab #B4-235-016
R24 through R31	Resistor; fixed composition: 47 ohms, ±10%, 1W, Allen Bradley GB
R35, R37, R38	Resistor, fixed composition: 100,000 ohms, ±10%, 1/2W, Allen Bradley EB
S1 through S8	Assembly; sensitivity switch EAI C020 052 0A
S17 through S24	Switch, toggle: Cutler-Hammer #75634K
S25, S 27	Switch, Pushbutton: Hetherington #C1006
S26	Switch, Rotary Selector: Centralab #PA-2003
S28	Switch, toggle: Cutler-Hammer #7565K5
S29	Switch, Rotary Selector: Centralab #PA-2021
S30	Assembly; Speed control switch EAI C020 054 0A
S31	Switch, Pushbutton: Mossman #7603; with Ace Hard Rubber Insulation
XI1	Pilot Light Assembly: Dialco #137-7336-933
XI2	Pilot Light Assembly: Dialco #137-7336-931
XI3	Pilot Light Assembly: Dialco #137-7336-935
XI4 through XI9	Pilot Light Assembly: Circon #SCMLD-R (Less Insulating Washers)

C. Speed Control Switch 20.054.

Reference Symbol	Description
C1 through C3	Capacitor, fixed, paper dielectric, metallized: .25 mfd, ±20%, 200V; Aerovox P82Z
R31 through R33	Resistor; fixed, composition: 6800 ohms, ±10%, 1/2W; Allen Bradley EB
S1	Switch, pushbutton: eight stations; Mossman series #7608

d. Sensitivity Switch 20.052.

Reference Symbol	Description
P1	Connector, plug: Winchester Electronics, Monoblock, #M5PL-SH19
R1	Resistor; precision, 600K ±0.5% Weston Vamistor mod. #9851

Reference Symbol	Description
R2	Resistor; precision, 200K ±0.5% Weston Vamistor mod. #9851
R3	Resistor; precision, 100K ±0.5% Weston Vamistor mod. #9851
R4	Resistor; precision, 12,650 ±0.5% Weston Vamistor mod. #9851
R5	Resistor; precision, 26,750 ±0.5% Weston Vamistor mod. #9851
R6	Resistor; precision, 80,000 ±0.5% Weston Vamistor mod. #9851
R7	Resistor; precision, 240,000 ±0.5% Weston Vamistor mod. #9851
S1	Switch, pushbutton: Mossman series 7608

e. Calibrate Unit 48.002.

Reference Symbol	Description
C1	Capacitor; fixed, electrolytic, 500 mfd, 125V, Mallory #NP1255
C2	Capacitor; fixed, electrolytic, 2 mfd, +50%, -10%, 450V, Sprague #TVA1701
C3	Capacitor; fixed, electrolytic, 20 mfd, 150V, Sprague #TVA1410
C4, C5	Capacitor; fixed, paper 1 mfd 200V Aerovox #P82Z
C6, C7	Capacitor; fixed, .03 mfd, 400V (Button Ceramic)
CR1, CR2	Rectifier; Sarkes Tarzian #M-500
J17	Connector; Receptacle, Cannon #DPD-45-34P-1L
K1	Stepper switch, coil 60V dc, 150 ohms, 5 levels (1 bridging), interrupter-contact form C, off-normal contacts form C. Clare mod. A-243990
K2 through K4	Relay; coil #W7-1004, contact; 4 form C, 12 springs, Clare type GAC
K5	Relay; Clare, CP SK #5028
K6	Relay; coil 115V AC at 60 cps; Leach type 7-3-C
K7	Relay; coil 115V AC 60 cps; Leach type 7-1-C
R1, R2	Resistor; precision, 30 ohms ±1%, ±.005%, Stability EPR type N-112-E
R3	Resistor; precision, 65 ohms ±1%, ±.005%, Stability EPR type N-112-E
R4	Resistor; precision, 195 ohms ±1%, ±.005%, Stability, EPR type N-112-E
R5	Resistor; precision, 310 ohms ±1%, ±.005% Stability; Eastern Precision Resistor type N-112-E
R6, R7	Resistor; precision, 1200 ohms ±1%, ±.005%, Stability, EPR type N-114-E
R8	Resistor; fixed, composition 100K ohms ±10%, 1W Allen Bradley GB
R9	Resistor; fixed, composition 270 ohms ±10%, 1/2W Allen Bradley EB
R10	Resistor; fixed, composition 3900 ohms ±10%, 2W Allen Bradley HB
R11	Resistor; fixed, composition 33K ohms ±10%, 1/2W Allen Bradley EB
R12	Resistor; 470 ohms ±10%, 1W Allen Bradley AB
R14	Resistor; variable, composition, ABJLU5021
R15, R16	Resistor; 10 ohms ±10%, 1W Allen Bradley AB
T1	Transformer; power: step-up; EAI B684 005 0
XK5	Socket; tube: Octal; Eby #9751-3
	Fuse Block; Littelfuse #099062

f. Regulated Power Supply 10.014

Reference Symbol	Description
C1	Capacitor; 20 mfd, 450V Aerovox AEP4J
C2	Capacitor; 90 mfd, 500 V DC Mallory #FP187
C3	Capacitor; fixed, .047 mfd 600V DC Cornell Dubilier #PM6S47
CR1 through CR6	Rectifier; Sarkes Tarzian #M-500
J1	Connector; receptacle: Amphenol #143-015-01-1013
R1	Resistor; fixed, wirewound: 12,000 ohms, ±5%, 25W; Ward Leonard 25F1200WL
R2, R5	Resistor; fixed, composition 4700 ohms, ±10%, 1/2W Allen Bradley EB
R3, R4	Resistor; fixed, wirewound: 50 ohms, 10W, Ward Leonard
T1	Transformer; power, step-down, step-up: EAI B684 002 0
V1	Tube; electron: type 6336
XC1, XV1	Socket; tube: Octal, Eby #9751-3
	Assembly; regulator amplifier: 3033-10AA-2

g. Regulator Amplifier 3033-10AA-2.

Reference Symbol	Description
C1, C2	Capacitor; ceramic, 0.1 mfd, 600V, Centralab #DF-104
C3	Capacitor; ceramic, .02 mfd, 600V, Centralab #DD-203
R1	Resistor; fixed, composition 1.0 megohm ±10%, 1/2W Allen Bradley EB
R2	Resistor; fixed, composition 120K ohms ±10%, 1W Allen Bradley GB
R3	Resistor; fixed, composition 68K ohms ±10%, 1/2W Allen Bradley EB
R4, R9, R13	Resistor; fixed, composition 100K ohms ±10%, 1/2W Allen Bradley EB
R5	Resistor; fixed, composition 470K ohms ±10%, 1/2W Allen Bradley EB
R6, R8	Resistor; fixed, composition 56K ohms ±10%, 1/2W Allen Bradley EB
R7	Resistor; fixed, composition 43K ohms ±5%, 1W, Allen Bradley GB
R10	Resistor; variable, Allen Bradley #TKRU2532
R11	Resistor; fixed, composition 330K ohms ±10%, 1/2W Allen Bradley EB
R12	Resistor; fixed, composition 220K ohms ±10%, 1/2W Allen Bradley EB
V1	Tube; electron: type 6AU6
V2	Tube; electron: type 12AX7
V3	Tube; electron: type 5651
XV1, XV3	Socket; tube, 7 pin min Methode #PS-151
XV2	Socket; tube, Noval, Methode #PS-161

h. 1 Second Event Marker and Filament Supply 36.001.

Reference Symbol	Description
C1	Capacitor; 0.25 mfd 200V DC, Aerovox type #P88N, Duranite
M1	Timer kit; 1 sec. brush #BL989F
R1	Resistor; fixed, composition 6,800 ohms ±10%, 1/2W Allen Bradley EB
TB1	Terminal Strip Cinch-Jones #14-140-y

Reference Symbol	Description
T1	Transformer; filament, 6.3V at 20 amp triad #F-22A
T2	Transformer; filament, 6.3V at 6 amp triad #F-18A

(1) Parts List 036.001 1P. The 36.001-1 is identical to the 36.001-0 except that Timer Kit has been replaced for 50 cycle operation.

Reference Symbol	Description
M1	Timer Kit; 1 sec. 115V, 50 cps Motor Speed 60 rpm at output shaft, rotation racing shaft CCW, shaft #A8X767-3, RW cramer type 117P

i. Relay Chassis 11.039.

Reference Symbol	Description
	Relay, coil, 115V AC, Leach #7-4-a

j. Wiring Harness 18.135.

Reference Symbol	Description
K3	Relay Time Delay, Amperite #115N060T

k. Equipment Mounting Plate 99.107.

Reference Symbol	Description
R1	Resistor; fixed, composition 200K ±10%, 1/2W, Allen Bradley EB
R2	Resistor; fixed, composition 68K ohms, ±10%, 2/2W, Allen Bradley EB
R3	Resistor; fixed, composition 15K ohms, ±10%, 2W, Allen Bradley HB
V1	Tube, electron: type 0A2

l. Network Unit 12.091

Reference Symbol	Description
C1	Capacitor; .33 mfd 200V Sprague #196 P334 0252
R1	Resistor; 100K ±1%, Vamistor 1/2W
R2	Resistor; 100K ±.5%, Vamistor 1/2W
R3	Resistor; 12K ±.5%, Vamistor 1/2W
R4	Resistor; variable, composition ABTKRU 2522
R5	Resistor; 4.8K ±.5%, Vamistor 1/2W
R6	Resistor; 500,000 ohms ±.5%, Vamistor 1/2W
R7	Resistor; variable, composition ABTKRU 1042
R8	Resistor; 120K ±5%, 1W, AB
R9	Resistor; variable, composition ABTKRU 5002
R10, R11	Resistor; 10K ±5%, 1/2W, AB
R12	Resistor; variable, composition Allen Bradley TKRU 2512
R13	Resistor; fixed, wirewound: 9,000 ohms 10W
R14	Resistor; 500,000 ohms, ±.5% Vamistor 1/2W
V1	Tube, electron: type 6AL5

m. D.C. Amplifier 3033-6A-3.

Reference Symbol	Description
C1	Capacitor; 1000 mfd Cornell-Dubilier #K069
C2	Capacitor; Mylar, .022 mfd 400V DCW Cornell Dubilier #STM4S22
C3	Capacitor; 27 mfd Cornell Dubilier L10Q27
C4	Capacitor; 0.02 mfd Cornell Dubilier BYB6S2

Reference Symbol	Description
C5	Capacitor; 0.2 mfd Cornell Dubilier BYB6S2
C6	Capacitor; 1.0 mfd, Aerovox Aerolite type P82 200V
CR1	Diode; Germanium Crystal #1N34A
D1	Converter, Airpax #A-175 6.3V AC 600PS
I1	Lamp; neon, NE-2
R1	Resistor; fixed, composition: 1.2 megohms, ±10%, 1/2W Allen Bradley EB
R2	Resistor; fixed, composition: 560K ±10%, 1/2W Allen Bradley EB
R3	Resistor; fixed, composition: 91K ±5%, 1/2W Allen Bradley EB
R4	Resistor; fixed, composition: 47K ±10%, 1/2W Allen Bradley EB
R5	Resistor; fixed, composition: 620K ±10%, 1/2W Allen Bradley EB
R6, R15, R23	Resistor; fixed, composition: 100K ±10%, 1/2W Allen Bradley EB
R7	Resistor; fixed, composition: 2.7 megohms, ±10%, 1/2W, Allen Bradley EB
R8	Resistor; variable, composition: 1 megohm, ±20%, 1W #TKRU1052
R9	Resistor; fixed, composition: 270K ±10%, 1/2W Allen Bradley EB
R10	Resistor; fixed, composition: 1.6 megohms ±5%, 1/2W, Allen Bradley EB
R11, R21, R25	Resistor; fixed, composition: 1.0 megohms ±10%, 1/2W, Allen Bradley EB
R12	Resistor; fixed, composition: 560K ±10%, 1/2W Allen Bradley EB
R13	Resistor; fixed, wirewound: 1250 ohms, 5W, Ward Leonard
R14	Resistor; fixed, composition: 2.2 megohms ±10%, 1/2W Allen Bradley EB
R16, R18	Resistor; fixed, composition: 4.7 megohms ±10%, 1/2W Allen Bradley EB
R17, R19	Resistor; fixed, composition: 470K ±10%, 1/2W Allen Bradley EB
R20	Resistor; fixed, composition: 56K ±10%, 1/2W Allen Bradley EB
R22	Resistor; fixed, composition: 47 megohms ±10%, 1/2W Allen Bradley EB
R24	Resistor; fixed, composition 8.2 megohms ±10%, 2W, International Resistance Type BW-2 #RU-6C8 R2K
V1	Electron Tube; type 6072
V2, V4	Electron Tube; type 12AX7
V3	Electron Tube; type 5763
XD1	Socket, tube: seven pin; Methode #P151
XV1 through XV4	Socket, tube: noval, Methode #P161

7. LIST OF DRAWINGS

The first drawing in this list, D099 003 0S, is a schematic diagram of the Control Circuits of the recorder. The second drawing, D099 003 0W is the wire list.

Each drawing number contains three elements; a letter prefix, the component model number, and a letter suffix. As an example, consider drawing C010 014 0S. The letter prefix C has no significance to this manual. The number 010 014 0 contains the model number which is found on the component, in this instance Power Supply 10.014. The letter suffix S indicates the drawing is a schematic diagram. A W would indicate wiring diagram.

In a few cases drawing numbers are used which have not yet been changed to conform to this system, such as C3033S6A-2. A more detailed description accompanies these designations.

Drawing Number	Title
D099 003 0S	Control Circuits, Recorder, Schematic, sheet 1.
D099 003 0S	Signal Circuits, Recorder, Schematic, sheet 2.
D018 135 0W	Wiring Harness, Wiring
B019 014 0A	Cables, Recorder to 231R Computer Console
B019 015 0A	Cables, Recorder to 231R Computer Console
D020 050 0S	Control Panel 20.050, Schematic
D020 050 0W	Control Panel 20.050, Wiring Sheets 1 & 2 of 5
C020 054 0W	Speed Control Switch 20.054, Wiring
B020 052 0W	Sensitivity Switch 20.052, Wiring
D048 002 0S	Calibrate Unit 48.002, Schematic
D048 002 0W	Calibrate Unit 48.002, Wiring
C010 014 0S	Regulated Power Supply (300V) 10.014, Schematic
C010 014 0W	Regulated Power Supply 10.014, Wiring
B3033S10AA-2	Regulator Amplifier 3033-10AA-2, Schematic
B036 001 0S	Event Marker and Filament Supply 36.001, Schematic
B036 001 0W	Event Marker and Filament Supply 36.001, Wiring
B011 039 0W	Relay Chassis 11.039, Wiring
D099 107 0W	Equipment Mounting Plate 99.107, Wiring Sheet 1
B012 091 0S	Network 12.091, Schematic
C3033S6A-3	DC Amplifier 3033-6A-3, Schematic

*CABLE EXISTING ON C047 004 0A

WIRING HARNESS
WIRING D018 135 0W
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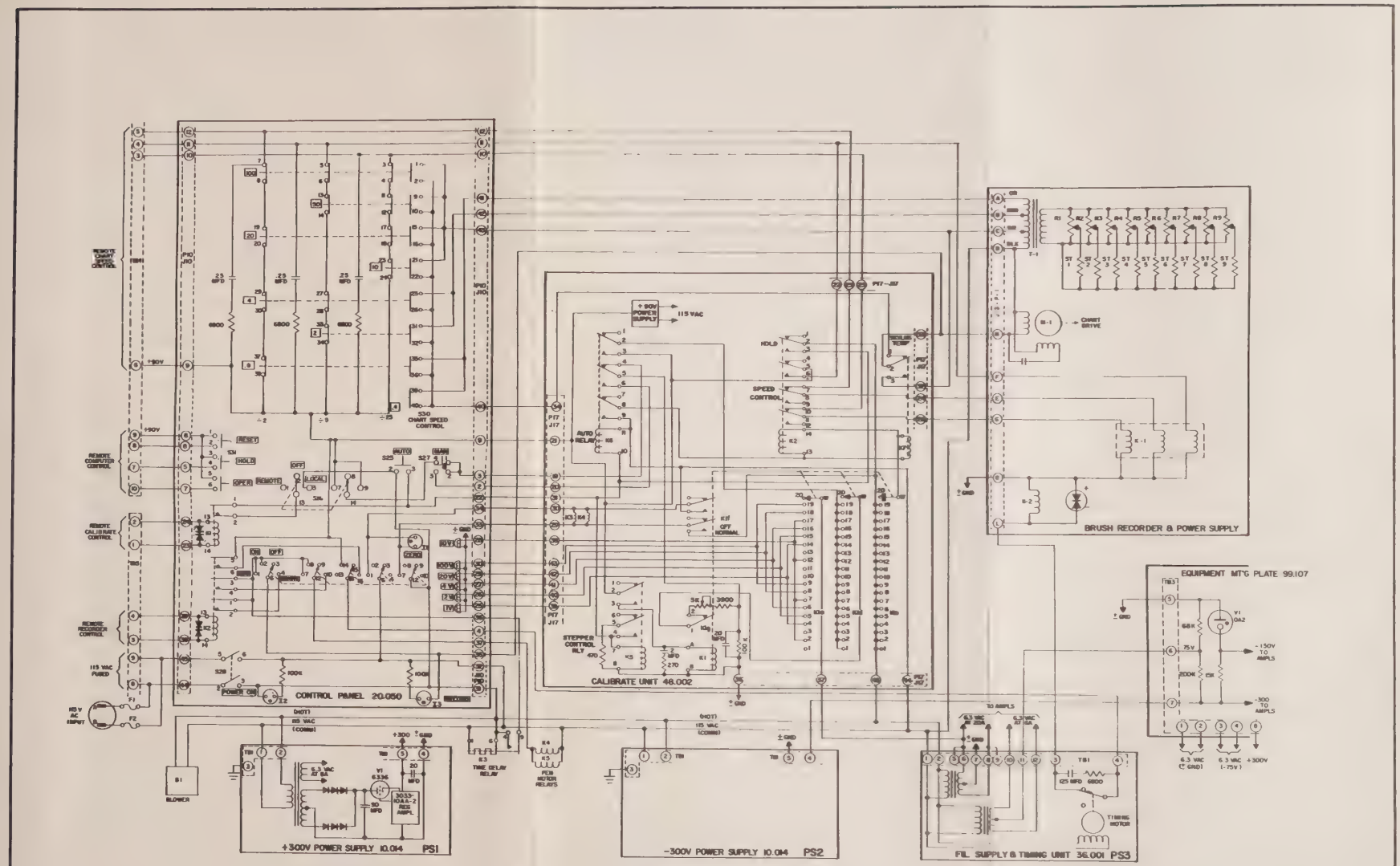
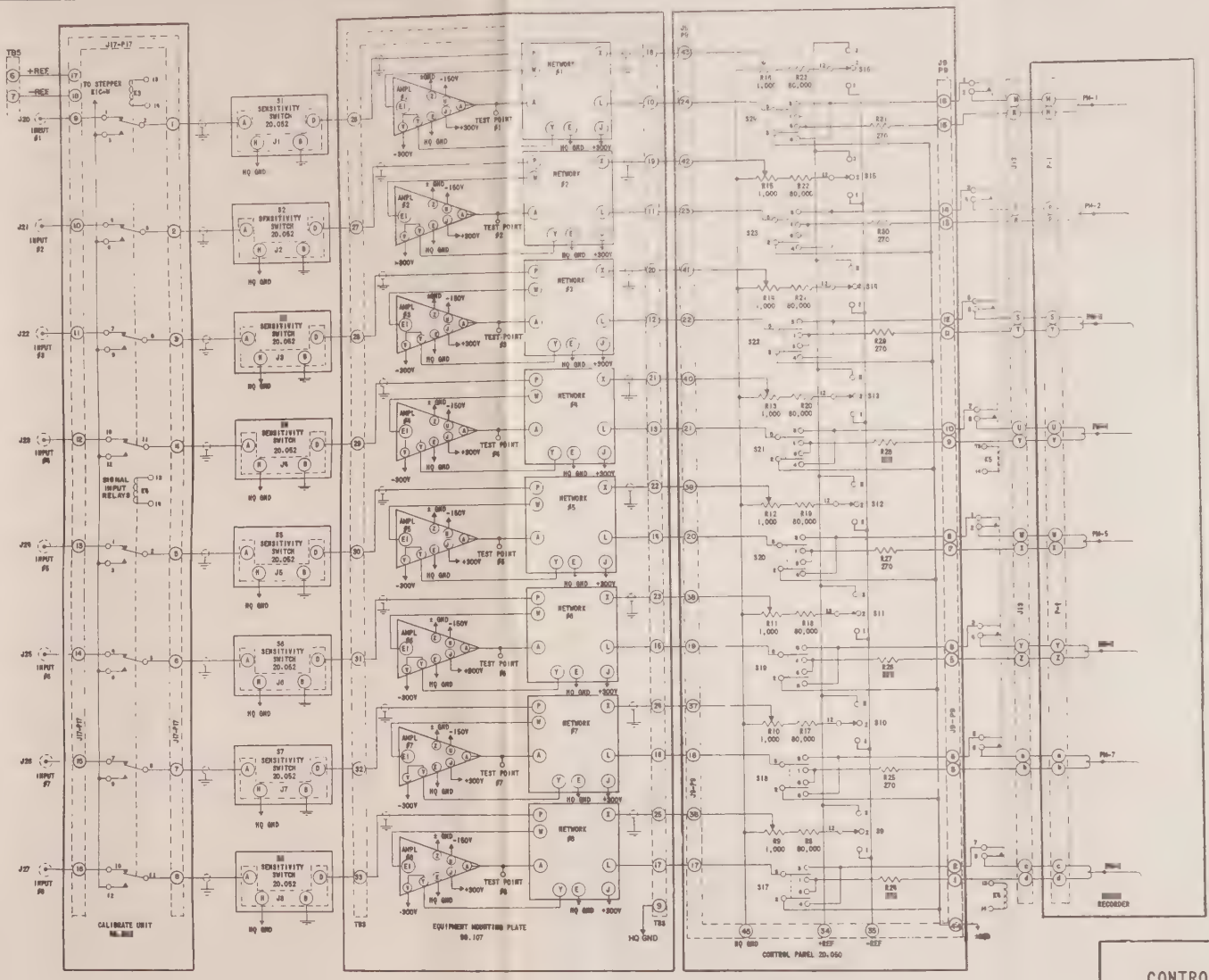


CONTROL CIRCUITS, RECORDER

SCHEMATIC, D099 003 0S

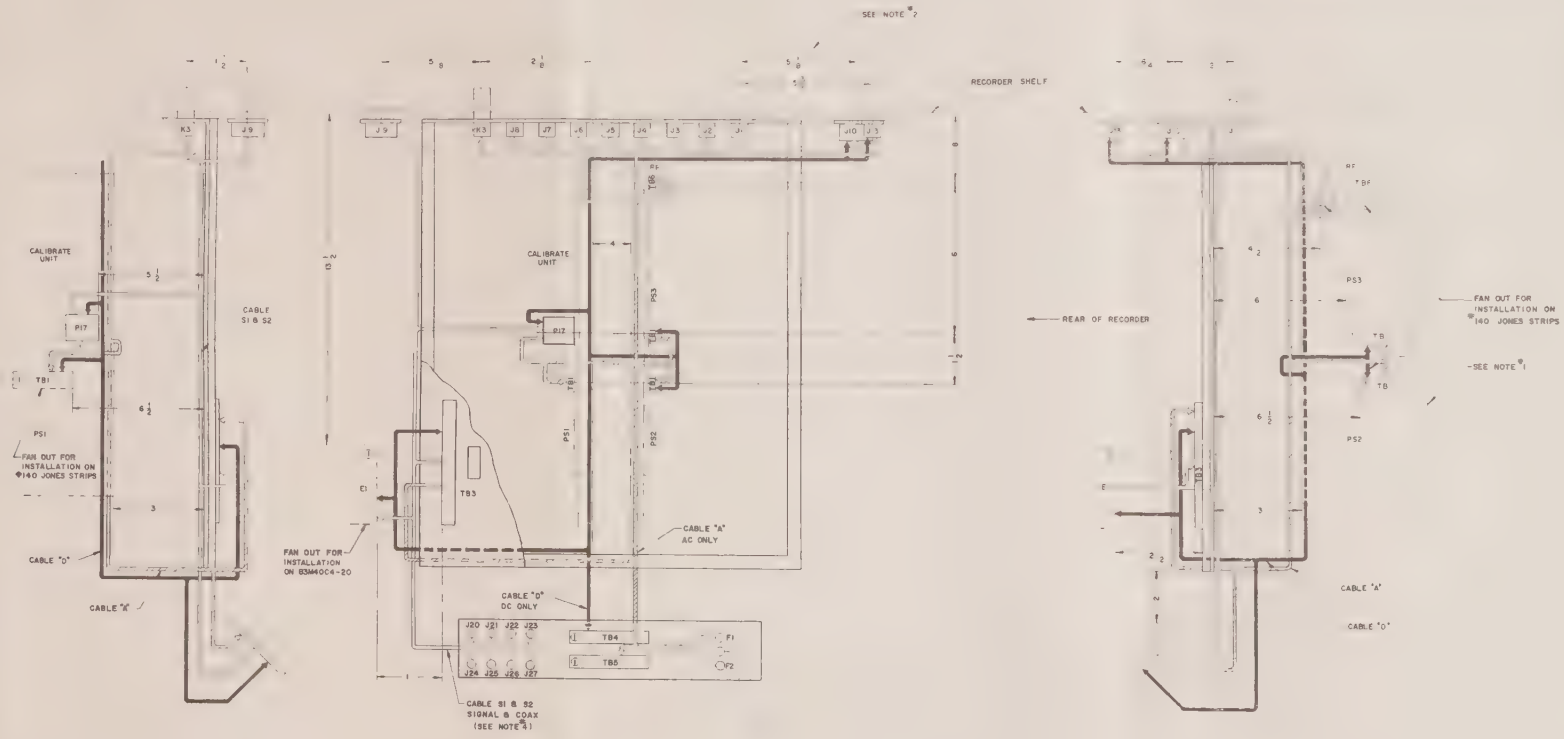
SHT. 1 OF 2



CONTROL CIRCUITS, RECORDER

SCHEMATIC D099 003 0S

SHT. 2 OF 2



WIRING HARNESS

WIRING D018 135 OW

SHT. 1 OF 10

J1 Thru J8 (Sensitivity Switches) Winchester #455-LRN

CABLE	TERMINAL	FUNCTION	DESTINATION	WIRE	DESTINATION	WIRE	DESTINATION	WIRE
S2	J1-A	Switch Input	P17-1	COAX				
S1	J1-B	Chassis Gnd	E1-33	BLK 16				
S2	J1-D	Switch Output	TB3-26	COAX				
S1	J1-H	HQ Gnd	E1-1	BLK 16				
S2	J2-A	Switch Input	P17-2	COAX				
S1	J2-B	Chassis Gnd	E1-34	BLK 16				
S2	J2-D	Switch Output	TB3-27	COAX				
S1	J2-H	HQ Gnd	E1-2	BLK 16				
S2	J3-A	Switch Input	P17-3	COAX				
S1	J3-B	Chassis Gnd	E1-35	BLK 16				
S2	J3-D	Switch Out	TB3-28	COAX				
S1	J3-H	HQ Gnd	E1-3	BLK 16				
S2	J4-A	Switch Input	P17-4	COAX				
S1	J4-B	Chassis Gnd	E1-36	BLK 16				
S2	J4-D	Switch Out	TB3-29	COAX				
S1	J4-H	HQ Gnd	E1-4	BLK 16				
S2	J5-A	Switch Input	P17-5	COAX				
S1	J5-B	Chassis Gnd	E1-37	BLK 16				
S2	J5-D	Switch Out	TB3-30	COAX				
S1	J5-H	HQ Gnd	E1-5	BLK 16				
S2	J6-A	Switch Input	P17-6	COAX				
S1	J6-B	Chassis Gnd	E1-38	BLK 16				
S2	J6-D	Switch Out	TB3-31	COAX				
S1	J6-H	HQ Gnd	E1-6	BLK 16				
S2	J7-A	Switch Input	P17-7	COAX				
S1	J7-B	Chassis Gnd	E1-39	BLK 16				
S2	J7-D	Switch Out	TB3-32	COAX				
S1	J7-H	HQ Gnd	E1-7	BLK 16				
S2	J8-A	Switch Input	P17-8	COAX				
S1	J8-B	Chassis Gnd	E1-40	BLK 16				
S2	J8-D	Switch Out	TB3-33	COAX				
S1	J8-H	HQ Gnd	E1-8	BLK 16				

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WIRING D018 135 OW
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J9 (Control Panel) Cannon #DPD-45-33S-1L

CABLE	TERMINAL	FUNCTION	DESTINATION	WIRE	DESTINATION	WIRE	DESTINATION	WIRE
W1	J9-1	Pan Motor Drive	J13-d	BLK				
	-2		RP-TB6-14	YEL				
	-3		J13-b	BLK				
	-4		RP-TB6-12	YEL				
	-5		J13-Z	BLK				
	-6		RP-TB6-16	YEL				
	-7		J13-X	BLK				
	-8		RP-TB6-19	YEL				
	-9		J13-V	BLK				
	-10		RP-TB6-6	YEL				
	-11		J13-T	BLK				
	-12		RP-TB6-4	YEL				
	-13		J13-R	BLK				
	-14		RP-TB6-8	YEL				
	-15		J13-M	BLK				
	-16	Pan Motor Drive	RP-TB6-11	YEL				
	-17	Ort Network 8	TB3-17					
	-18	7	TB3-16					
	-19	6	TB3-15					
	-20	5	TB3-14					
	-21	4	TB3-13					
	-22	3	TB3-12					
	-23	2	TB3-11					
	-24	Ort Network 1	TB3-10	YEL				
	-25	Chassis Gnd	E1-23	BLK 16				
	-26							
	-27							
	-28	Chassis Gnd	E1-25	BLK 16				
	-29							
	-30							
	-31							
	-32							
	-33							
	-34	+100V Ref	TB5-6	WH-RED18				
	-35	-100V Ref	TB5-7	WH-VI 18				
	-36	Pan Pos #8	TB3-25	COAX				
	-37	#7	-24					
	-38	#6	-23					
	-39	#5	-22					
	-40	#4	-21					
	-41	#3	-20					
	-42	#2	-19					
	-43	Pan Pos #1	TB3-18	COAX				
	-44	± Gnd	E1-21	BLK 16				
W1	J9-45	HQ Gnd	E1-24	BLK 16				

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WIRING D018 135 OW
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J10(Control Panel) Cannon #DFD-4S-33S-1L

CABLE	TERMINAL	FUNCTION	DESTINATION	WIRE	DESTINATION	WIRE	DESTINATION	WIRE
	J10-1							
D	-2	+90V(Switched)	P17-20	OR				
	-3	+90V	P17-19					
	-4	+90V	FS3-TB1-4					
	-5	Hold	TB4-7					
	-6	+90V(In)	TB4-9					
	-7	Operate	TB4-10					
	-8	Reset	TB4-8					
	-9	+90V	P17-21		TB4-6	OR		
	-10	± 25 V	P17-25		TB4-3	OR		
	-11	± 5 V	P17-22		TB4-4	OR	J13-F	OR
	-12	±.2 V	P17-23	OR	TB4-5	OR		
D	-13							
	-14							
	-15							
	-16							
	-17							
	-18							
	-19							
	-20							
	-21							
A	-22	115V AC(SW)	P17-31	GY				
	-23	Cal Control	TB5-1	WH				
	-24	Cal Control	TB5-2	GY				
	-25	+1V Indicator	P17-39	BRN				
	-26	+2V Indicator	P17-40					
	-27	+4V Indicator	-41					
	-28	+10V Indicator	-38					
	-29	+20V Indicator	-42					
	-30	+100V Indicator	P17-43	BRN				
	-31	115V AC(Hot)	FS3-TB1-2	GY 16				
	-32	115V AC (Com)	FS3-TB1-1	WH 16				
	-33	115V AC (SW)	P17-29	GY				
	-34	115V AC (SW)	P17-30	WH				
A	-35	115V AC (Hot)	P17-33	GY 16	J13-H	GY 16		
	-36	115V AC Time Dly	K3-9	GY 16				
	-37	Pen Motor Rly	RP-TB6-1	GY				
	-38	Rel Control	TB5-3	WH 16				
	-39	Rel Control	TB5-4	GY 16				
	-40	Stylus Temp	P17-34	GY 18				
	-41		J13-A					
	-42		J13-B					
A	-43	Stylus Temp	P17-32	GY 18	J13-C	GY 18		
A	-44	115V AC Fused	F1-2	GY 14				
A	J10-45	115V AC Fused	F2-2	WH 14				

WIRING HARNESS
WIRING D018 135 OW
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J13 (To Recorder) Amphenol #AN3100A-28-15S, J20-J27 Amphenol Subminax #27-3

CABLE	TERMINAL	FUNCTION	DESTINATION	WIRE	DESTINATION	WIRE	DESTINATION	WIRE
A	J13-A	115V (Switched)	J10-41	GY 16				
A	-B	115V (Switched)	J10-42	GY 16				
A	-C	115V (Switched)	J10-43	GY 16				
A	-D	115V AC (Com)	RP-TB6-2	WH 16				
D	-E	Chart Speed	P17-24	OR				
D	-F	Chart Speed	J10-11	OR				
D	-G	Chart Speed	P17-26	OR				
A	-H	115V AC (Hot)	J10-35	GY 16				
D	-L	+90V	P93-TB1-3	OR				
SH	-M	Pen Motor Drive	RP-TB6-10	YEL				
	-N		J9-15	BLK				
	-P		RP-TB6-9	YEL				
	-R		J9-13	BLK				
	-S		RP-TB6-5	YEL				
	-T		J9-11	BLK				
	-U		RP-TB6-7	YEL				
	-V		J9-9	BLK				
	-W		RP-TB6-16	YEL				
	-X		J9-7	BLK				
	-Y		RP-TB6-17	YEL				
	-Z		J9-5	BLK				
	-a		RP-TB6-13	YEL				
	-b		J9-3	BLK				
	-c		RP-TB6-15	YEL				
S1	-d	Pen Motor Drive	J9-1	BLK				
D	J13-e	± Gnd	K1-26	BLK 16				
S2	J20	Signal Input 1	P17-9	COAX				
	J21	2	P17-10					
	J22	3	P17-11					
	J23	4	P17-12					
	J24	5	P17-13					
	J25	6	P17-14					
	J26	7	P17-15					
S2	J27	Signal Input 8	P17-16	COAX				
A	K3-1	115V AC (Com)	RP-TB6-2	WH 16				
A	-4	115V AC (Hot)	K3-6	SD-BUS18				
A	-6	115V AC (Hot)	P17-45	GY 16	K3-4	18 SD-BUS		
A	K3-9	115V AC Tim Dly	J10-34	GY 16				

WIRING HARNESS
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F17 (CALIBRATE UNIT) Cannon #DPD-45-33S-1L

CABLE	TERMINAL	FUNCTION	DESTINATION	WIRE	DESTINATION	WIRE	DESTINATION	WIRE
S2	F17-1	Switch Input#1	J1-A	COAX				
	2	2	J2-A					
	3	3	J3-A					
	4	4	J4-A					
	5	5	J5-A					
	6	6	J6-A					
	7	7	J7-A					
	8	Switch Input#8	J8-A					
	9	Signal Input#1	J20					
	10	2	J21					
	11	3	J22					
	12	4	J23					
	13	5	J24					
	14	6	J25					
	15	7	J26					
S2	16	Signal Input#8	J27	COAX				
S1	17	+ 100V Ref	TB5-6	WH-RED 18				
S1	18	-100V Ref	TB5-7	WH-VI 18				
D	19	+90V (SW)	J10-3	OR				
	20	+90V (SW)	J10-2	OR				
	21	+90V	J10-9	OR				
	22	5	J10-11	OR				
	23	2	J10-12	OR				
	24	Chart Speed	J13-E	OR				
	25	25	J10-10	OR				
D	26	Chart Speed	J13-G	OR				
	27							
	28							
A	29	115V AC (SW)	J10-33	GY				
	30	115V AC (SW)	J10-34	WH				
	31	115V AC (SW)	J10-22	GY				
	32	Stylus Temp	J10-43	GY 18				
	33	115V AC (Hot)	J10-35	GY 16				
A	34	Stylus Temp	J10-40	GY 18				
D	35	Chassis Gnd	K1-28	BLK 16				
D	36	± Gnd	E1-22	BLK 16				
A	37	+ 3.1V AC	PS3-TB1-5	BRN 22				
	38	+10V Indicator	J10-28					
	39	+1V	J10-25					
	40	+2V	J10-26					
	41	+4V	J10-27					
	42	+20V	J10-29					
	43	+100V Indicator	J10-30	BRN 22				
	44	11.7 AC (Comm)	PS1-TB1-1	WH 16				
A	F17-45	11.7 AC (Hot)	PS1-TB1-2	GY 16	K3-6	GY 16		

WIRING HARNESS
WIRING D018 135 OW
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PS1 - (+300 Power Supply) PS3 (Fil Supply and Timing Unit)
PS2 - (-300 Power Supply)

CABLE	TERMINAL	FUNCTION	DESTINATION	WIRE	DESTINATION	WIRE	DESTINATION	WIRE
A	PS1-TB1-1	115V AC (Com)	PS2-TB1-1	WH 16	P17 44	WH 16		
A	2	115V AC (Hot)	PS2-TB1-2	GY 16	P17-45	GY 16		
-	3	Chassis Gnd	E1-30	BLK 16				
D	4	± Gnd	PS2-TB1-5	BLK 16	K1-9	BLK 16		
D	PS1-TB1-5	+300V at .5A	TB3-8	RED 20				
A	PS2-TB1-1	115V AC (Com)	PS1-TB1-1	WH 16	PS3-TB1-1	WH16		
A	2	115V AC (Hot)	PS1-TB1-2	GY 16	PS3-TB1-2	GY 16		
-	3	Chassis Gnd	E1-31	BLK 16				
D	4	-300V at .5A	TB3-7	VI 20				
D	PS2-TB1-5	± Gnd	PS1-TB1-4	BLK 16				
A	PS3-TB1-1	115V AC (Com)	PS2-TB1-1	WH 16	J10-32	WH 16	RP-TB6-2	WH 16
A	2	115V AC (Hot)	PS2-TB1-2	GY 16	J10-31	GY16		
D	3	+90V	J13-L	OR 20				
D	4	+90V	J10-X	OR 20				
A	5	6.3V AC (Gnd)	TB3-1	BRN-TP16	J17-37	BRN		
A	6	6.3V AC (Gnd)	TB3-1	BRN-TP16				
A	7	6.3V AC (+ CT)	K1-12	BLK 16				
A	8	6.3V AC (Gnd)	TB3-2	WH-BRN-TP	16			
A	9	6.3V AC (Gnd)	TB3-2	WH-BRN-TP	16			
A	10	6.3V AC (-75V)	TB3-3	BRN-VI-TP	16			
A	11	6.3V AC (CT -75V)	TB3-6	WH-VI 20				
A	PS3-TB1-12	6.3V AC (-75V)	TB3-4	WH-VI-TP	16			
A	RP-TB6-1	Pen Motor Relay	J9-37	GY 20				
A	-2	Pen Motor Relay	PS3-TB1-1	WH 16	K3-1	WH 16	J13-D	WH 16
	-3							
S1	-4	Pen Motor Drive	J9-12	YEL 20				
	-5		J13-S					
	-6		J9-10					
	-7		J13-U					
	-8		J9-14					
	-9		J13-P					
	-10		J13-N					
	-11		J9-16					
	-12		J9-4					
	-13		J13-a					
	-14		J9-2					
	-15		J13-c					
	-16		J9-6					
	-17		J13-Y					
	-18		J13-W					
S1	RP-TB6-19	Pen Motor Drive	J9-8	YEL 20				

WIRING HARNESS
WIRING D018 135 OW
SHT. 8 OF 10

TB3 (Equipment Mt'g Plate)

CABLE	TERMINAL	FUNCTION	DESTINATION	WIRE	DESTINATION	WIRE	DESTINATION	WIRE
A	TB3-1	6.3V AC (Cmd)	PS3-TB1-5	BRN-TP16	PS3-TB1-6	BRN-TP16		
A	-2	6.3V AC (Cmd)	PS3-TB1-8	WH-BRN TP-16	PS3-TB1-9	WH-BRN TP-16		
A	-3	6.3V AC(-75V)	PS3-TB1-10	BRN-VI-TP-16				
A	-4	6.3V AC (-75V)	PS3-TB1-12	WH-VI TP-16				
D	-5	± Cmd	E1-10	BLK 16				
D	-6	-75V	PS3-TB1-11	WH-VI 20				
D	-7	-300V	PS2-TB1-4	VI 20				
D	-8	+300V	PS1-TB1-5	RED 20				
S1	-9	EQ Cmd	E1-11	BLK 16				
S1	-10	Output #1	J9-24	YEL 20				
S1	-11	Output #2	J9-23	YEL 20				
S1	-12	Output #3	J9-22	YEL 20				
S1	-13	Output #4	J9-21	YEL 20				
S1	-14	Output #5	J9-20	YEL 20				
S1	-15	Output #6	J9-19	YEL 20				
S1	-16	Output #7	J9-18	YEL 20				
S1	-17	Output #8	J9-17	YEL 20				
S2	-18	Pen Pos #1	J9-43	COAX				
S2	-19	Pen Pos #2	J9-42					
S2	-20	Pen Pos #3	J9-41					
S2	-21	Pen Pos #4	J9-40					
S2	-22	Pen Pos #5	J9-39					
S2	-23	Pen Pos #6	J9-38					
S2	-24	Pen Pos #7	J9-37					
S2	-25	Pen Pos #8	J9-36	COAX				
S2	-26	Sensitivity #1	J1-D	COAX				
S2	-27	#2	J2-D					
S2	-28	#3	J3-D					
S2	-29	#4	J4-D					
S2	-30	#5	J5-D					
S2	-31	#6	J6-D					
S2	-32	#7	J7-D					
S2	-33	Sensitivity #8	J8-D	COAX				
D	-34	Chassis Gnd	E1-29	BLK 16				
	-35							
	-36							
	TB3-37							

WIRING HARNESS

WIRING D018 135 OW

SHT. 9 OF 10

TB4 TB5 (To Computer)

CABLE	TERMINAL	FUNCTION	DESTINATION	WIRE	DESTINATION	WIRE	DESTINATION	WIRE
D	TB4-3	± 25	J10-10	OR				
D	-4	± 5	J10-11	OR				
D	-5	±	J10-12	OR				
D	-6	+90V (Out)	J10-9	OR				
D	-7	Hold	J10-5	OR				
D	-8	Reset	J10-8	GR				
D	-9	+90V (In)	J10-6	OR				
D	TB4-10	Operate	J10-7	GR				
A	TB5-1	Cal Control	J10-23	WH 16				
A	-2	Cal Control	J10-24	GY 16				
A	-3	Rec Control	J10-38	WH 16				
A	-4	Rec Control	J10-39	GY 16				
S1	-5	EQ Gnd	K1-27	BLK 16				
S1	-6	+ Ref	P17-17	WH-RED18	J9-34	WH-RED18		
S1	-7	- Ref	P17-18	WH-VI 18	J9-35	WH-VI 18		
A	-8	115V AC (Fused)	F1-2	GY 14				
A	TB5-9	115V AC (Fused)	F2-2	WH 14				

WIRING HARNESS

WIRING D018 135 OW

SHT. 10 OF 10

TERMINAL	DESTINATION	IDENTIFICATION	WIRE TYPE & SIZE	COLOR & LENGTH
TB4-7	BT-3	Hold	PTG 18	BLK
TB4-8	BT-2	Reset	PTG 18	BLK
TB4-9	BT-1	+90V	PTG 18	BLK
TB4-10	BT-4	Operate	PTG 18	BLK

MAT'L (PARTS LIST)

ITEM	SYMBOL	REQ'D	DESCRIPTION
			See Parts List A019 014 OP

B019 014 0A — PART NO

12'6"±3" — LENGTH

REMARKS Identify all leads with white spaghetti, lettered or rubber stamped with identification in accordance with terminals and destination columns.

CABLES, RECORDER TO 231R COMPUTER
CONSOLE B019 014 0A

TERMINAL	DESTINATION	IDENTIFICATION	WIRE TYPE & SIZE	COLOR & LENGTH
P20	RJ-A	Input #1	COAX	
P21	RJ-B	2		
P22	RJ-C	3		
P23	RJ-D	4		
P24	RJ-E	5		
P25	RJ-F	6		
P26	RJ-G	7		
P27	RJ-H	Input #8	COAX	
TB1	RJ-J	Relay Cmd	PHW-18	BLK
TB2	RJ-K	Remote Calibrate Control		
TB3	RJ-L	Remote Recorder Control	PHW-18	BLK
TB4	RJ-M	EQ Cmd		
TB5	RJ-N	+ Ref	PHW-18	BLK
TB6	RJ-P	- Ref		
TB7	RJ-R	Spare	PHW 18	BLK
TB8		Spare		
TB9		Spare		
TB10		Spare		

MAT'L (PARTS LIST)

ITEM	SYMBOL	REQ'D	DESCRIPTION
			See Parts List A019 015 OP

B019 015 0A — PART NO.

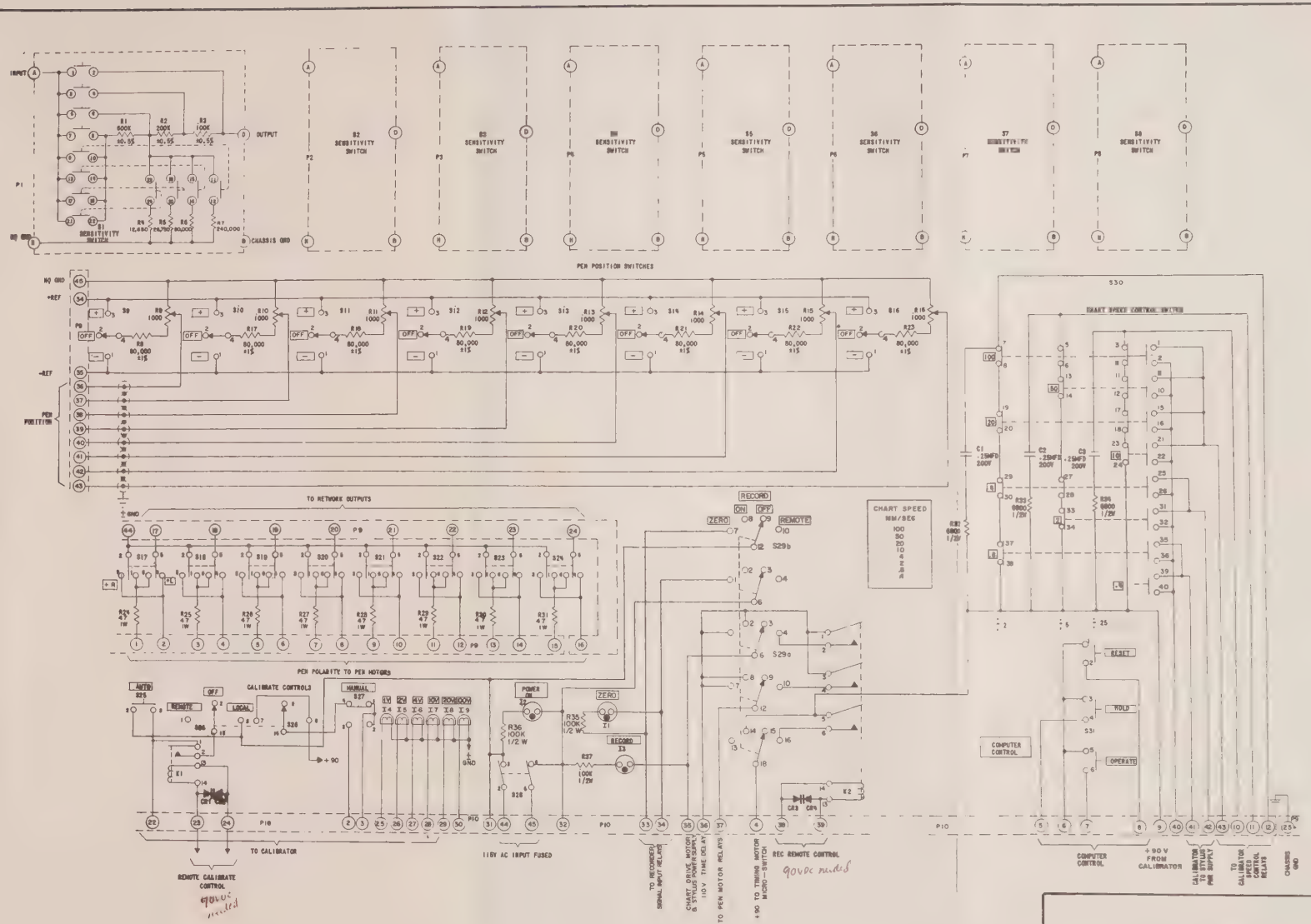
12'6"±3" — LENGTH

REMARKS

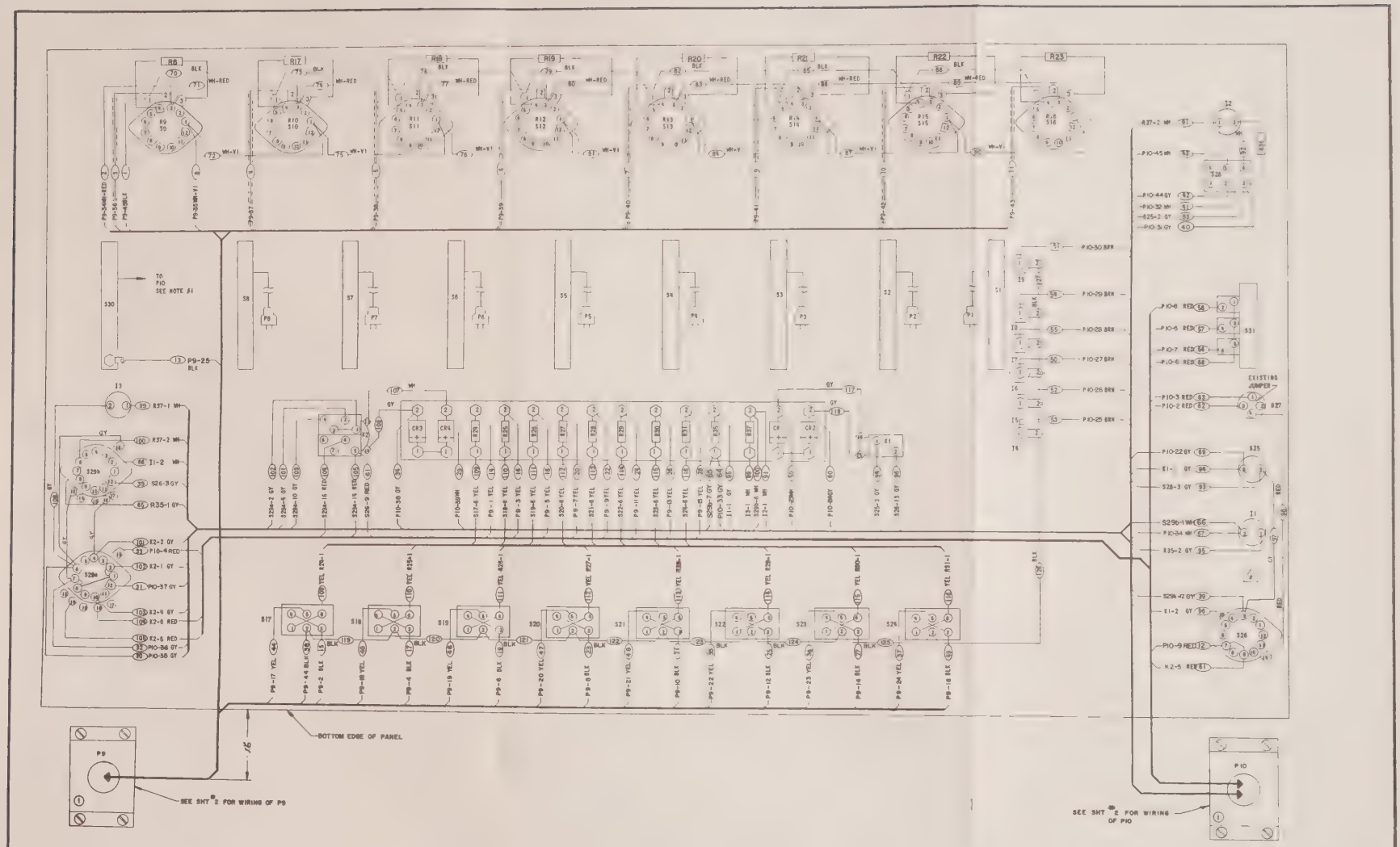
Identify All Leads With White Spaghetti, Lettered Or Rubber Stamped With Identification In Accordance With Terminal And Destination Columns.

CABLES, RECORDER TO 231R COMPUTER

CONSOLE B019 015 0A



CONTROL PANEL 20.050
SCHEMATIC, D020 050 0S

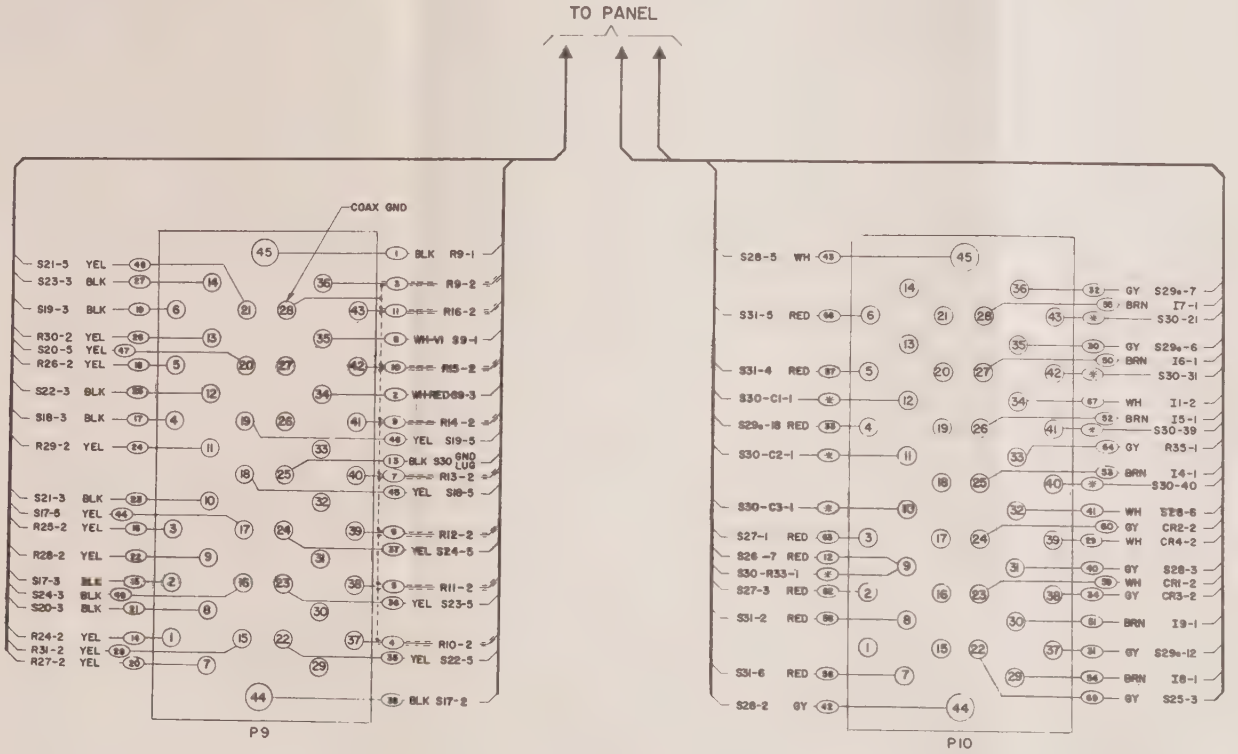


CONTROL PANEL 20.050

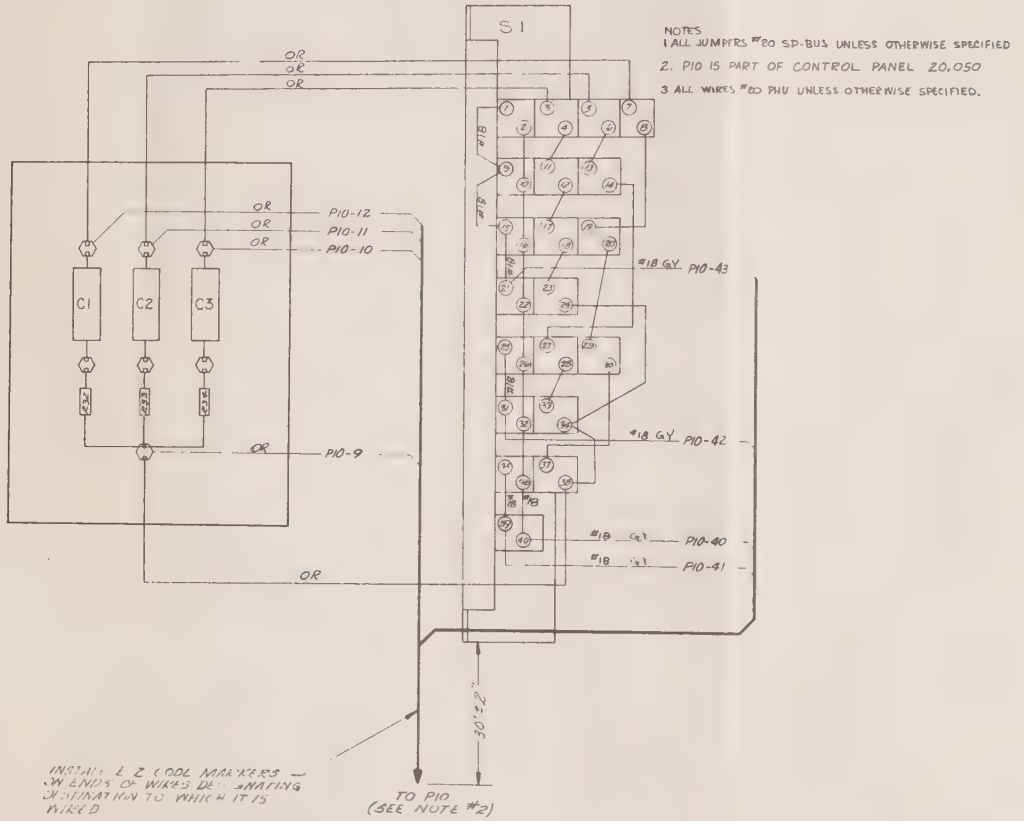
WIRING D020 050 OW

SHT. 1 OF 5

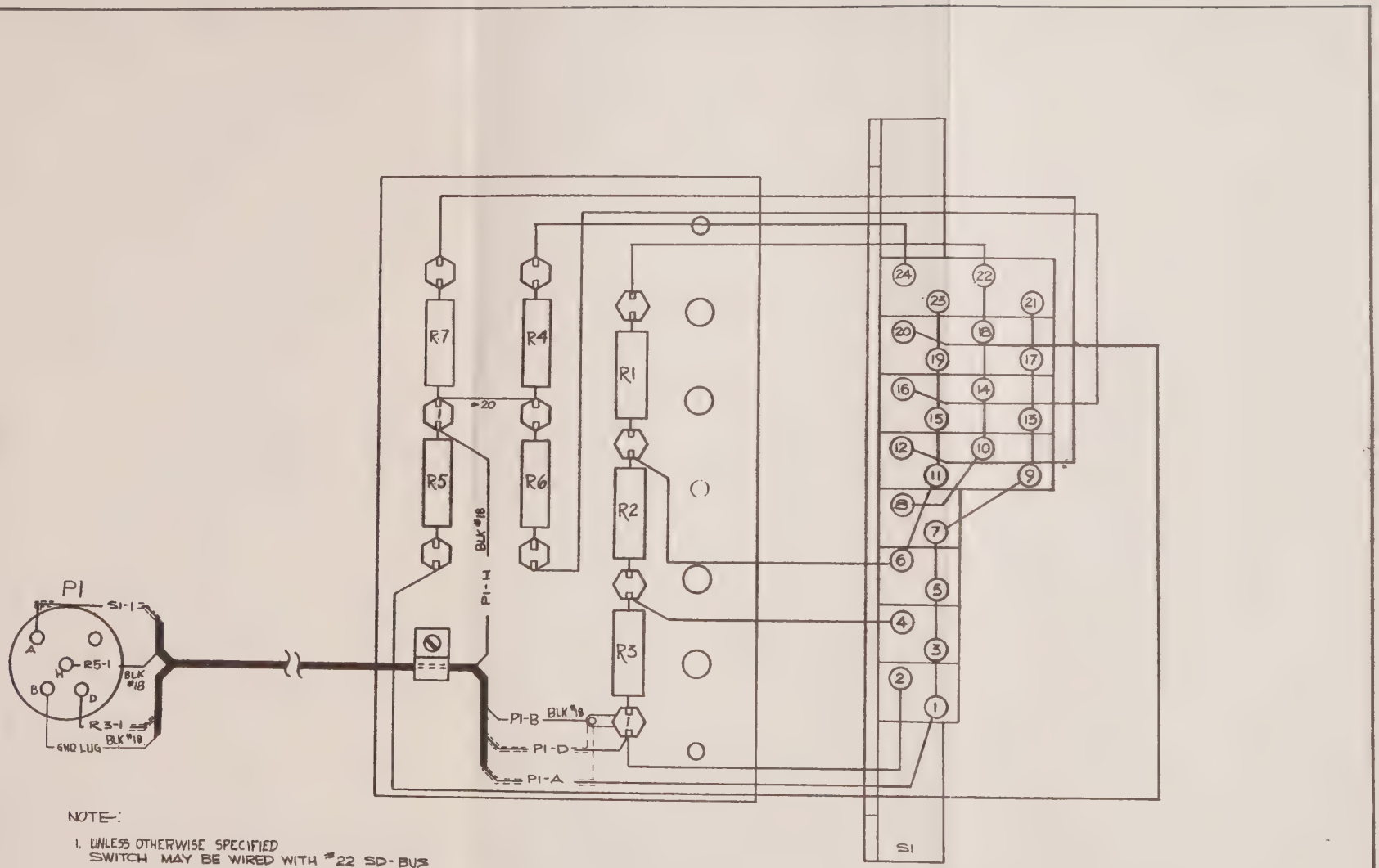
(*) THESE WIRES ARE PART OF SPEED CONTROL SWITCH ASSEMBLY 20.054.



CONTROL PANEL 20.050
WIRING D020 050 0W
SHT. 2 OF 5



SPEED CONTROL SWITCH 20.054,
C020 054 OW, WIRING

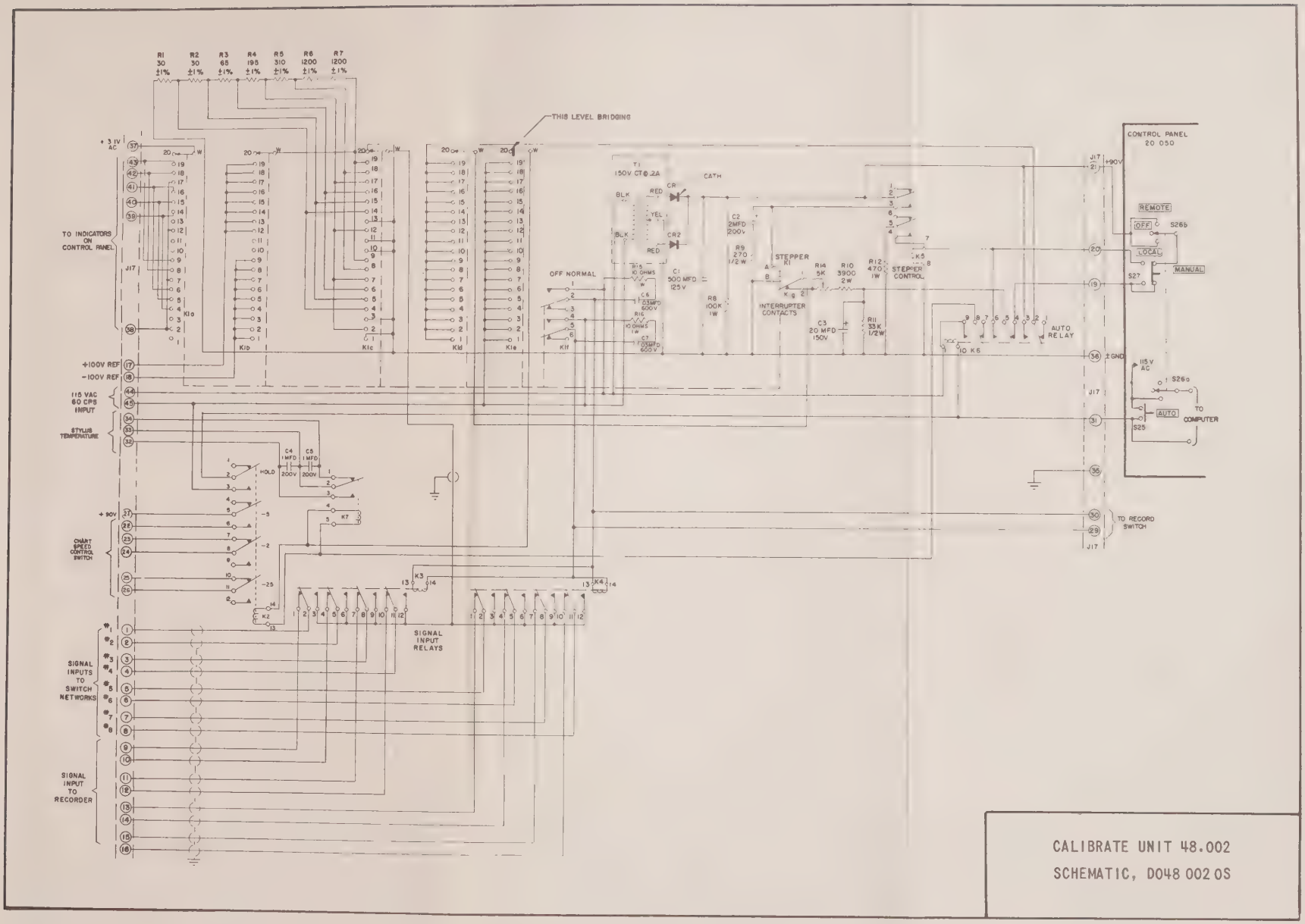


NOTE:

1. UNLESS OTHERWISE SPECIFIED SWITCH MAY BE WIRED WITH #22 SD-BUS COVERED WITH EXTRUDED PLASTIC TUBING OR WITH #20 GY. PHU.
2. ALL COAX RG-174/U – B916 001 0

SENSITIVITY SWITCH 20.052

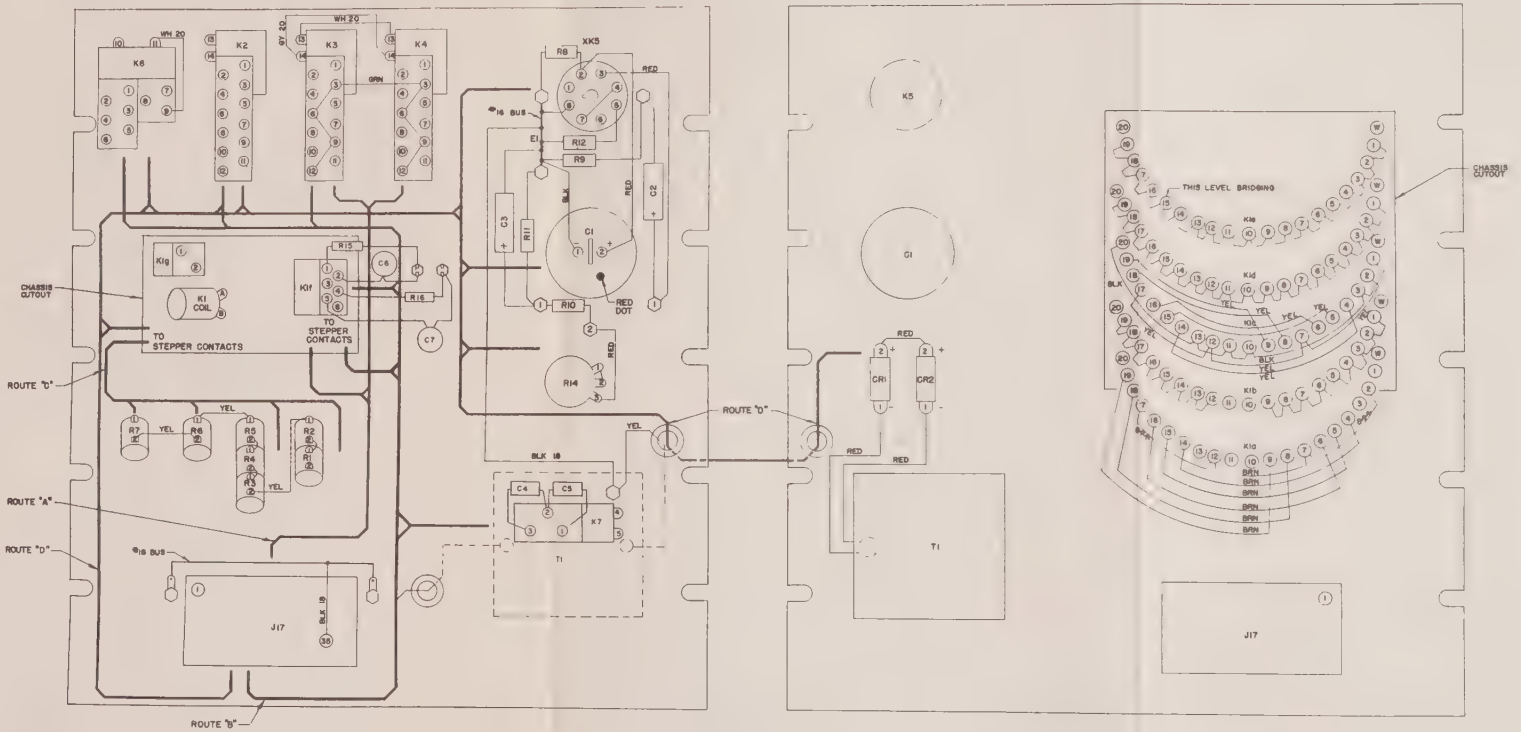
WIRING, B020 052 0W



CALIBRATE UNIT 48.002

SCHEMATIC, D048 002 0S

NOTES.
1. ALL JUMPERS #20 BUS UNLESS OTHERWISE SPECIFIED.
2. ALL WIRE PHU, AWG #22 UNLESS OTHERWISE SPECIFIED.



CALIBRATE UNIT 48.002
WIRING D048 002 0W
SHT. 1 OF 4

ROUTE	TERMINAL	FUNCTION	DESTINATION	WIRE	DESTINATION	WIRE	DESTINATION	WIRE
D	C1-2	+90V	K2-5	RED	CR1-2	RED		
D	C2-1	+90V (SW)	K1-A	RED				
D	CR1-2	+90V	C1-2	RED				
A	J17-1	Signal Input#1	K3-2	COAX				
	-2	2	K3-5					
	-3	3	K3-8					
	-4	4	K3-11					
	-5	5	K4-2					
	-6	6	K4-5					
	-7	7	K4-8					
	-8	8	K4-11					
	-9	1	K3-1					
	-10	2	K3-4					
	-11	3	K3-7					
	-12	4	K3-10					
	-13	5	K4-1					
	-14	6	K4-4					
	-15	7	K4-7					
	-16	Signal Input#8	K4-10	COAX				
	-17	+100V Ref	K1b-19	WH-RED20				
A	-18	-100V Ref	K1b-9	WH-VI 20				
D	-19	+90V (SW)	K6-4	RED				
	-20	+90V (SW)	K6-6					
	-21	+90V (SW)	K6-3					
	-22	Chart Speed	K2-6					
	-23		K2-7					
	-24		K2-8					
	-25		K2-10					
D	-26	Chart Speed	K2-11	RED				
	-27							
	-28							
B	-29	115V (Hot)	K1f-5	GY 20				
	-30	115V (COMM)	K1f-2	WH				
	-31	115V (hot)	K2-2	GY				
	-32	Stylus Temp	K7-3	GY				
	-33	Stylus Temp	K7-2	GY				
B	-34	Stylus Temp	K7-1	GY 20				
	-35							
D	-36	± Gnd	E1	BLK 18				
B	-37	3.1V Indicator	K1a-W	BRN				
	-38		K1a-17					
	-39		K1a-14					
	-40		K1a-15					
	-41		K1a-16					
	-42		K1a-18					
B	-43	3.1V Indicator	K1a-19	BRN				
B	-44	115V AC	T1*	BLK	K1f-1	WH 20		
B	J17-45	115V AC	T1*	BLK	K1e-13	GY 20	K1f-4	GY 20
	K7-1	Stylus Temp	J17-34	GY 20				
	K7-2	Stylus Temp	J17-33	GY				
	K7-3	Stylus Temp	J17-32	GY				
	K7-4	115V (Comm)	K2-14	GY 20				
B	K7-5	115V (Hot)	K2-13	WH 20				

*THESE WIRES EXISTING ON T1

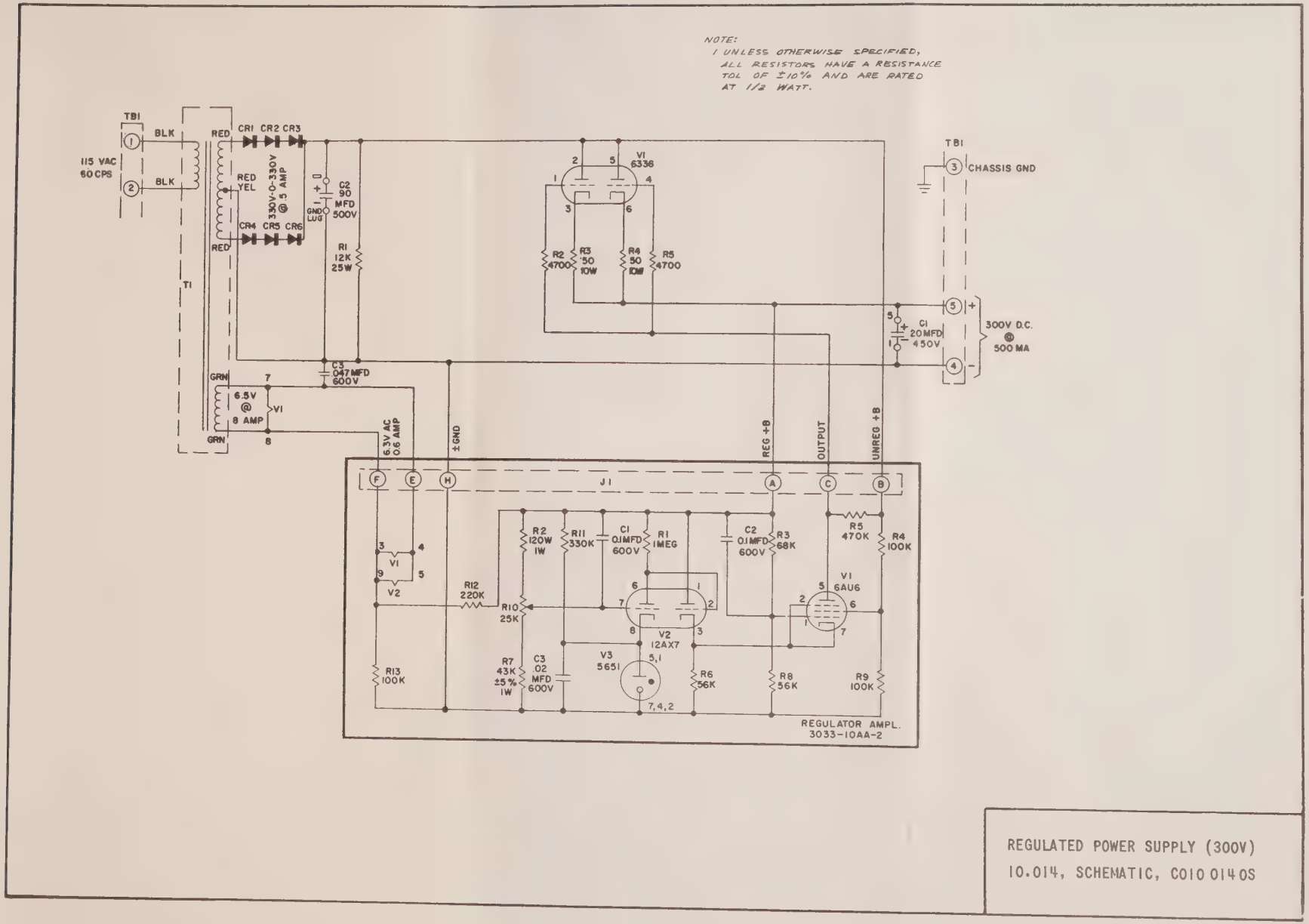
CALIBRATE UNIT 48.002
WIRING D048 002 OW
SHT. 2 OF 4

ROUTE	TERMINAL	FUNCTION	DESTINATION	WIRE	DESTINATION	WIRE	DESTINATION	WIRE
D	K1-A	+90	C2-1	RED				
D	K1-B	± Gnd	K1	BLK 18				
B	K1a-W	3.1V Indicator	J17-37	BRN				
	K1a-14		J17-39					
	-15		J17-40					
	-16		J17-41					
	-17		J17-38					
	-18		J17-42					
B	K1a-19	3.1V Indicator	J17-43	BRN				
C	K1b-W	± 100V Ref	K1c-9	YEL	R7-1	YEL		
A	K1b-9	-100V Ref	J17-18	WH-VI20				
A	K1b-19	+100V Ref	J17-17	WH-RED20				
A	K1c-W	Signal To Record	K3-12	COAX				
C	-1	± Gnd	R1-2	BLK 18				
	-2	± 10V Ref	R5-2	YEL				
	-4	± 1V Ref	R2-2	YEL				
	-5	± 2V Ref	R3-2	YEL				
	-6	± 4V Ref	R4-2	YEL				
	-8	± 20V Ref	R6-1	YEL				
C	-9	± 100V Ref	K1b-W	YEL				
D	K1c-20	± Gnd	K1	BLK 18				
D	K1d-W	+90V	K1g-1	RED				
D	K1d-19	+90V	K6-2	RED				
B	K1e-W	115V AC (Hot)	K2-14	GY 20				
B	K1e-19	115V AC (Hot)	J17-45	GY 20				
B	K1f-1	115V AC (Comm)	K6-9	WH 20	K17-44	WH 20		
	-2	115V AC (Comm)	K3-13	WH 20	J17-30	WH 20		
	-4	115V AC (Hot)	K2-3	GY 20	J17-45	GY 20		
B	K1f-5	115V AC (Hot)	K3-14	GY 20	J17-29	GY 20		
D	K1g-1	+90V	K1d-W	RED				
D	K1g-2	+90V	R14-1	RED				
B	K2-1							
B	K2-1							
B	-2	115V(Hot)	K6-10	GY 20	J17-31	GY 20		
B	-3	115V(Hot)	K1f-4	GY 20				
D	-4							
D	-5	+90V	C1-2	RED	K6-3	RED		
D	-6	CHART SPEED	J17-22	RED				
D	-7	Chart Speed	J17-23	RED				
	-8		J17-24	RED				
	-9							
D	-10	Chart Speed	J17-25	RED				
B	-11	Chart Speed	J17-26	GY 20				
	-12							
	-13	115V (Comm)	K6-8	WH 20	K7-5	WH 20		
B	K2-14	115V (Hot)	K1e-W	GY 20	K7-4	GY 20		

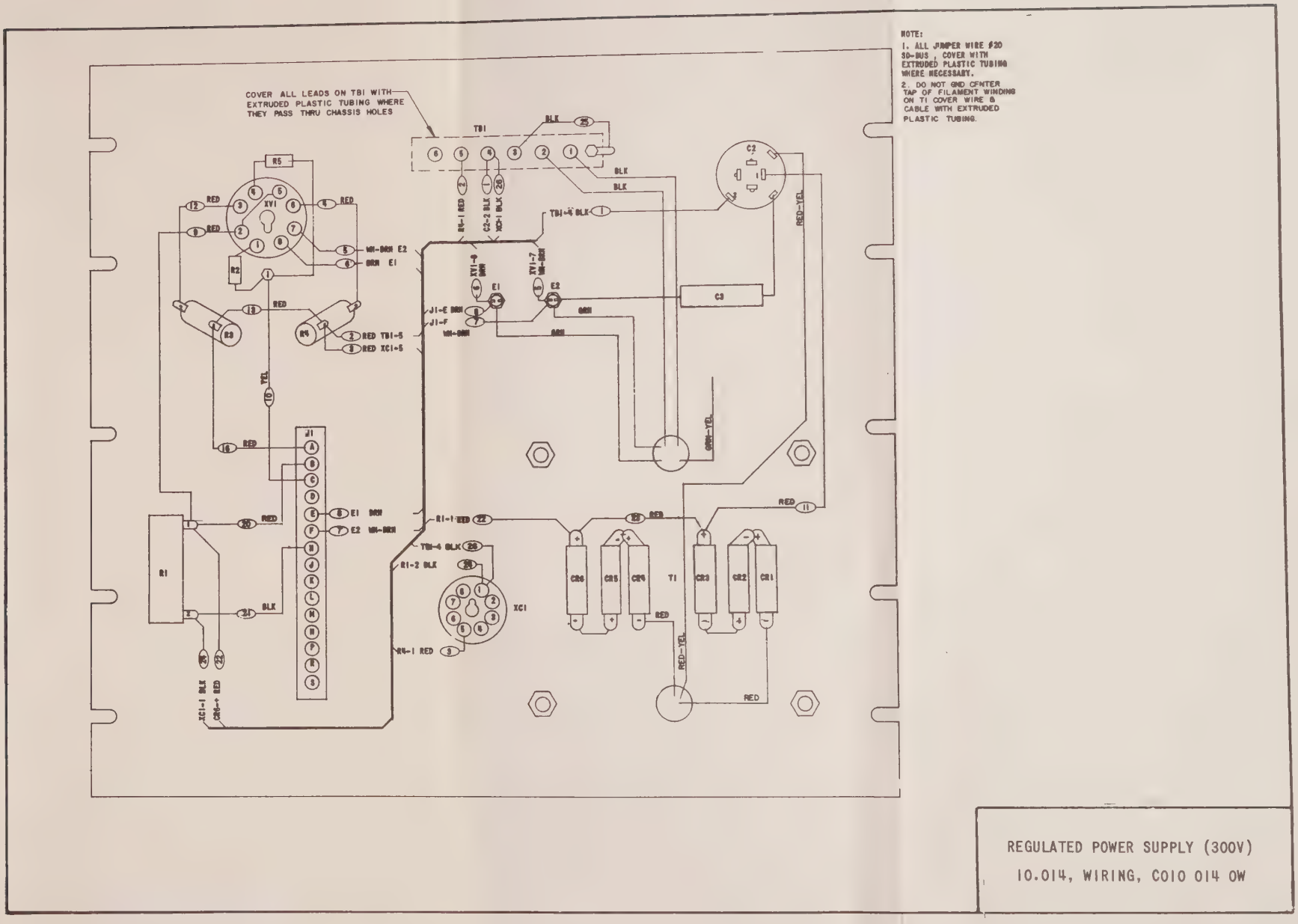
CALIBRATE UNIT 48.002
WIRING D048 002 0W
SHT. 3 OF 4

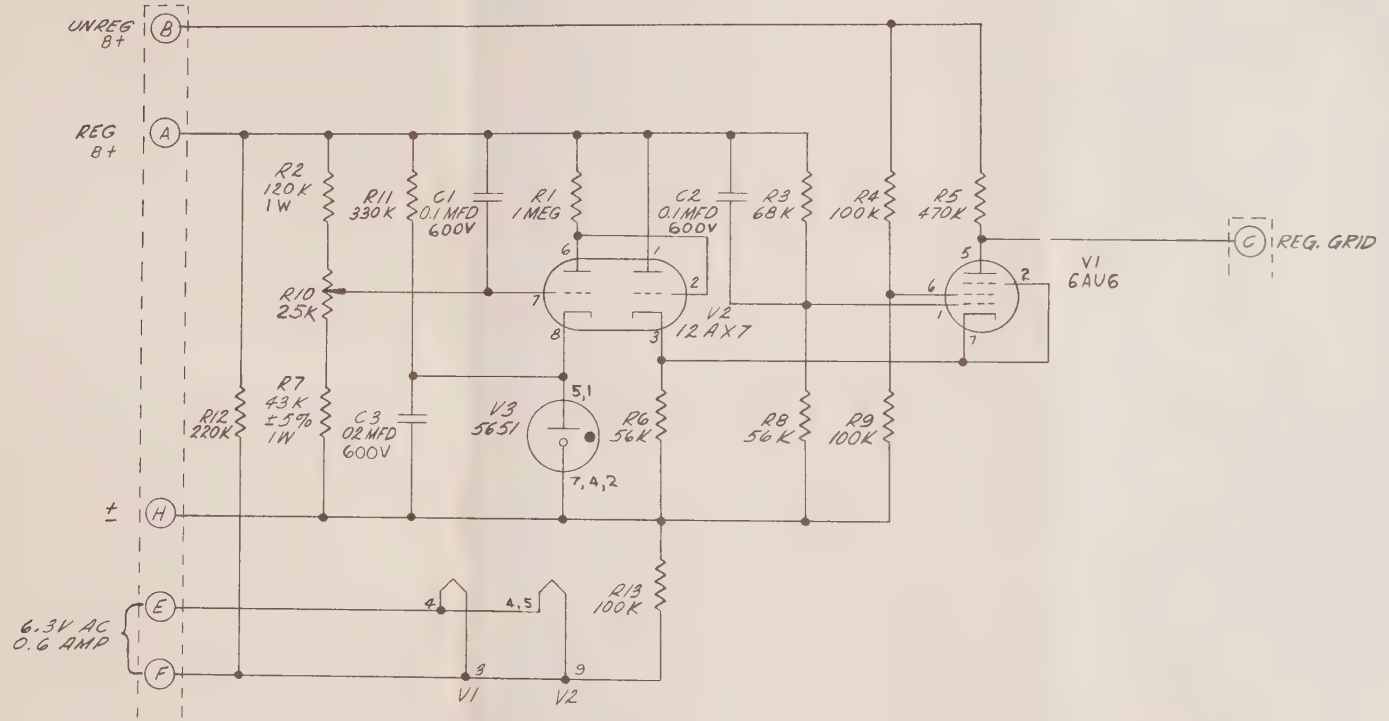
ROUTE	TERMINAL	FUNCTION	DESTINATION	WIRE	DESTINATION	WIRE	DESTINATION	WIRE
A	K3-1	Signal Input #1	J17-9	COAX				
	-2	1	J17-1					
	-3							
	-4	2	J17-10					
	-5	2	J17-2					
	-6							
	-7	3	J17-11					
	-8	3	J17-3					
	-9							
	-10	4	J17-12					
	-11	Signal Input #4	J17-4					
A	K3-12	Signal To Stepper	K1c-W	COAX				
A	K4-1	Signal Input #5	J17-13	COAX				
	-2	5	J17-5					
	-3							
	-4	6	J17-14					
	-5	6	J17-6					
	-6							
	-7	7	J17-15					
	-8	7	J17-7					
	-9							
	-10	8	J17-16					
A	K4-11	Signal Input #8	J17-8	COAX				
D	XK5-7	+90V	K6-6	RED				
	K6-1							
D	-2	+90V	K1d-19	RED				
	-3	+90V	K2-5	RED	J17-21	RED		
	-4	+90V	J17-19	RED				
	-5	+90V	R10-1	RED				
D	-6	+90V	XK5-7	RED	J17-20	RED		
	-7							
B	-8	115V AC (Comm)	K2-13	WH 20				
B	-9	115V AC (Comm)	K1f-1	WH 20				
B	K6-10	115V AC (Hot)	K2-Z	GY 20				
C	R1-2	± Gnd	K1c-1	BLK 18				
	R2-2	± 1V Ref	K1c-4	YEL				
	R3-2	± 2V Ref	K1c-5	YEL				
	R4-2	± 4V Ref	K1c-6	YEL				
	R5-2	± 10V Ref	K1c-2	YEL				
	R6-1	± 20V Ref	K1c-8	YEL				
C	R7-1	± 100V Ref	K1b-W	YEL				
D	R10-2	+90V	K6-5	RED				
I	R14-1	+90V	K1g-2	RED				

CALIBRATE UNIT 48.002
WIRING D048 002 OW
SHT. 4 OF 4



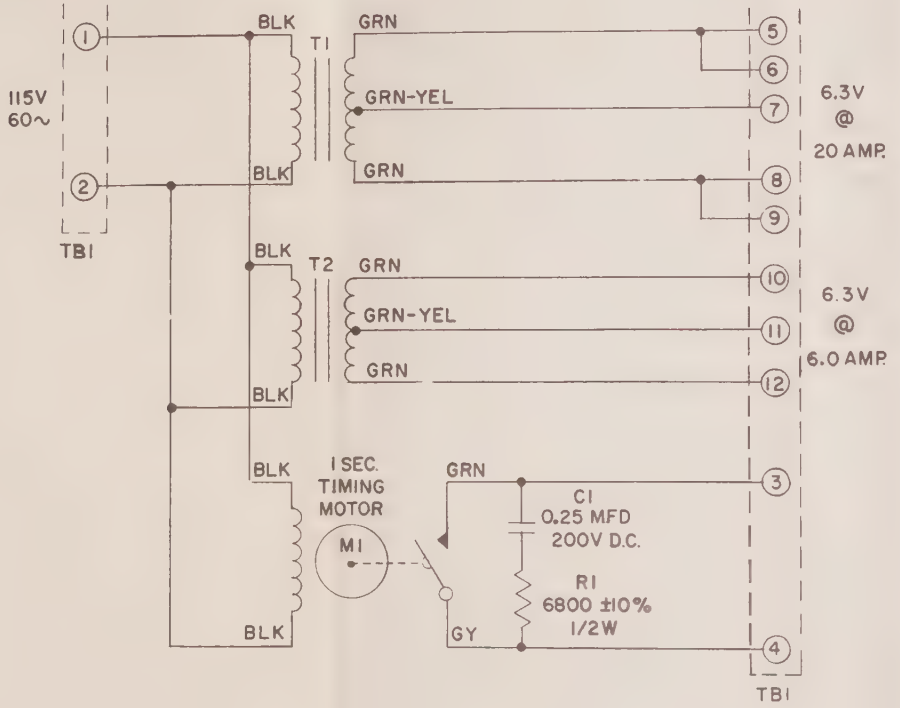
REGULATED POWER SUPPLY (300V)
10.014, SCHEMATIC, C010 0140S


NOTE:
1. ALL JUMPER WIRE #20 SO-BUS , COVER WITH EXTRUDED PLASTIC TUBING WHERE NECESSARY.
2. DO NOT GND CENTER TAP OF FILAMENT WINDING ON T1 COVER WIRE & CABLE WITH EXTRUDED PLASTIC TUBING.
COVER ALL LEADS ON TB1 WITH EXTRUDED PLASTIC TUBING WHERE THEY PASS THRU CHASSIS HOLES
TB1
BLK
RED
YEL
GRN
WH-GRN
RED-YEL
R1
R2
R3
R4
R5
C2
C3
J1
XV1
XC1
CR1
CR2
CR3
CR4
CR5
CR6
T1
E1
E2
REGULATED POWER SUPPLY (300V)
10.014, WIRING, C010 014 0W

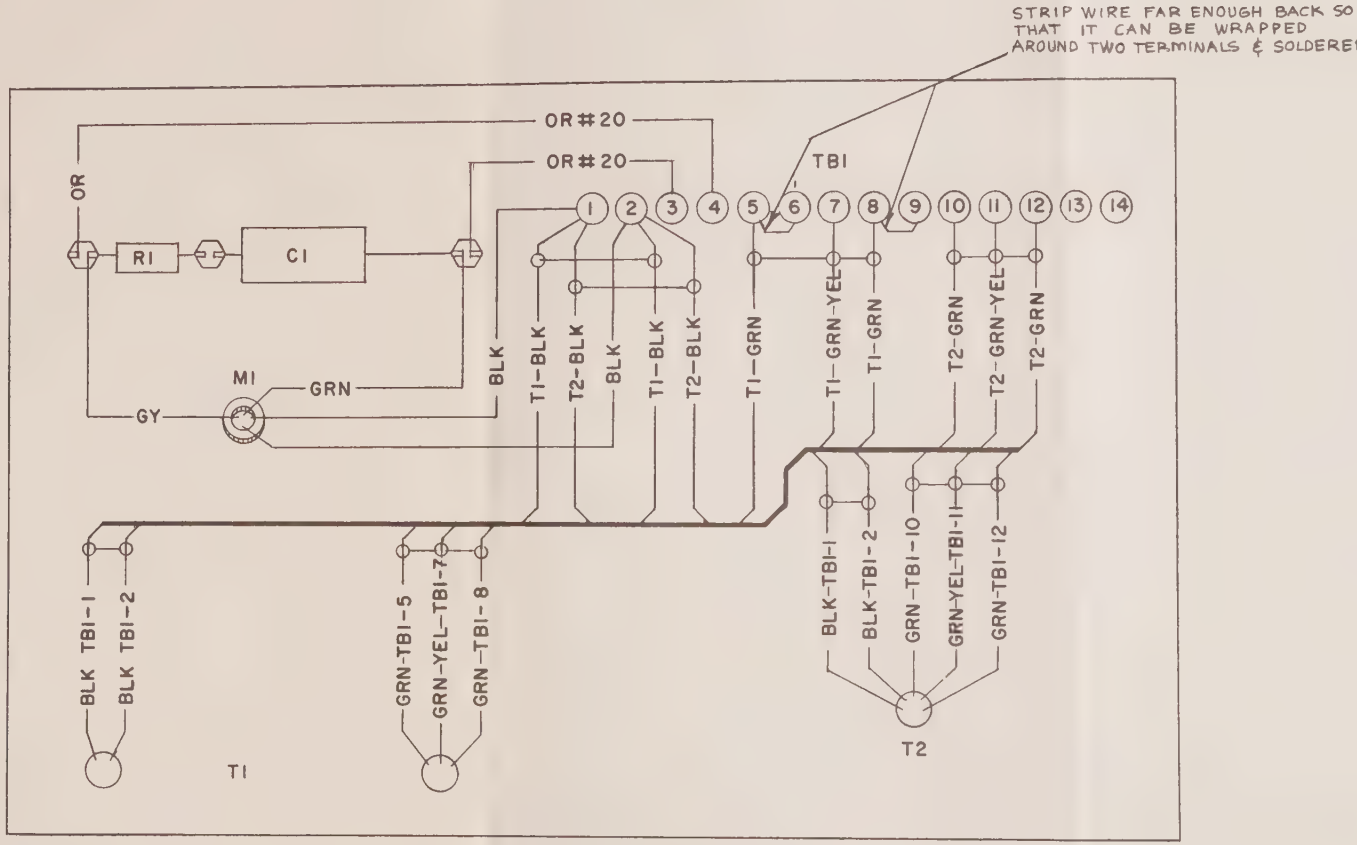


NOTES:
UNLESS OTHERWISE SPECIFIED ALL RESISTOR HAVE A RESISTANCE TOLERANCE OF ± 10% AND ARE RATED AT ½ WATT

REGULATOR AMPLIFIER 3033-10AA-2
SCHEMATIC, B3033S10AA-2



EVENT MARKER AND FILAMENT SUPPLY
36.001, SCHEMATIC, B036 001 0S

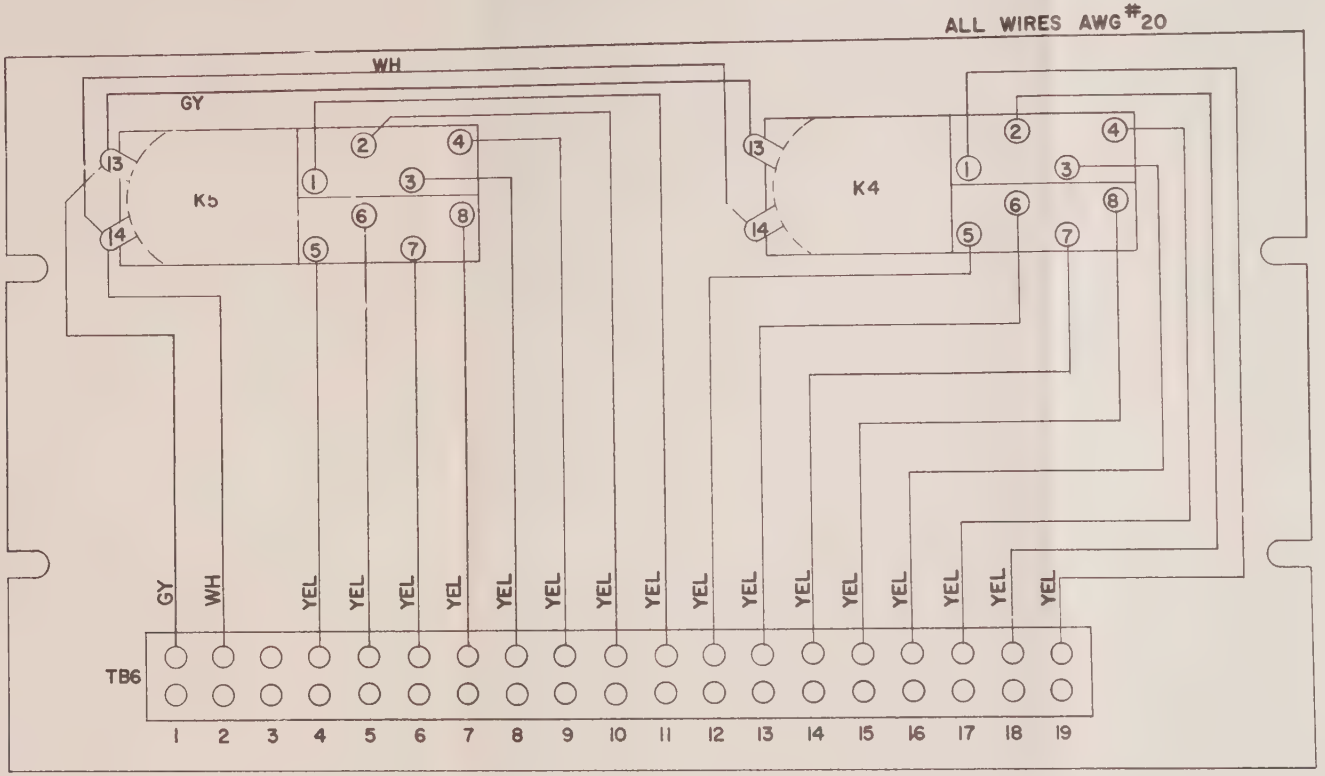


NOTES:

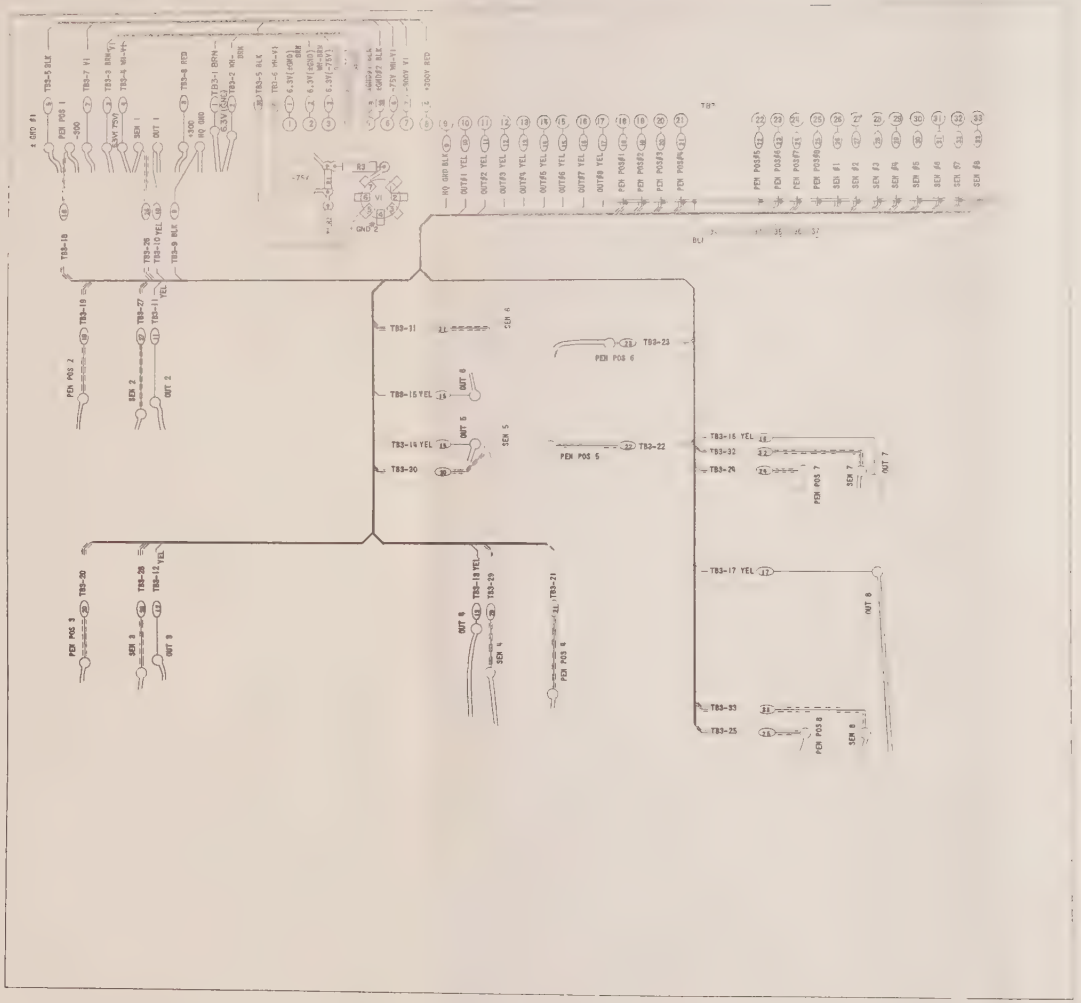
1. ALL WIRES ARE EXISTING LEADS ON THE COMPONENTS EXCEPT THE TWO ORANGE WIRES ON TBI-3 & 4.
2. TWIST ALL WIRES TOGETHER & LACE INTO A CABLE.
3. IT IS NOT NECESSARY TO OBSERVE THE POLARITY OF THE WIRES ON T1, T2 & M1.

EVENT MARKER AND FILAMENT SUPPLY

36.001, WIRING, B036 001 0W

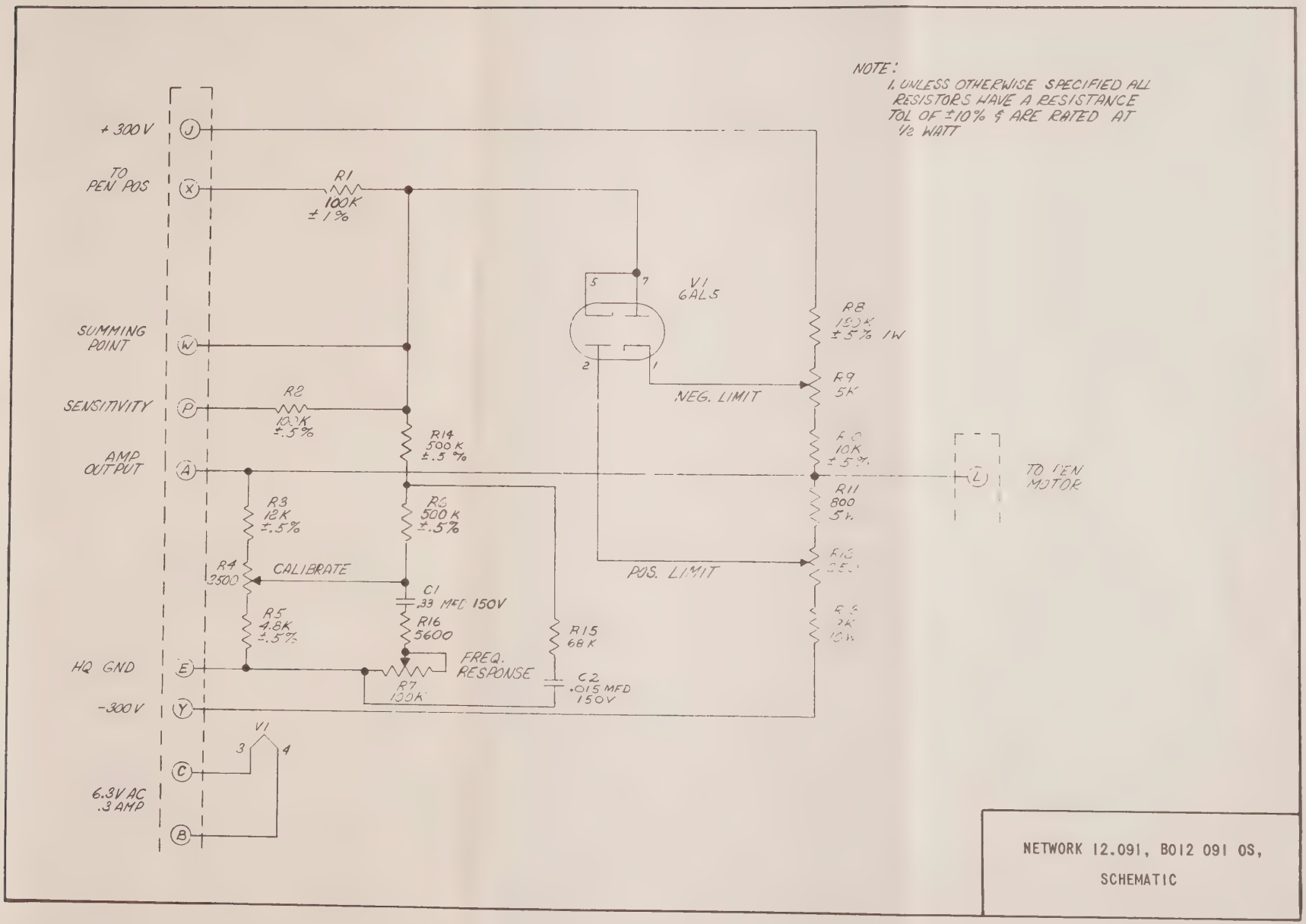


RELAY CHASSIS 11.039
WIRING, B011 039 0W

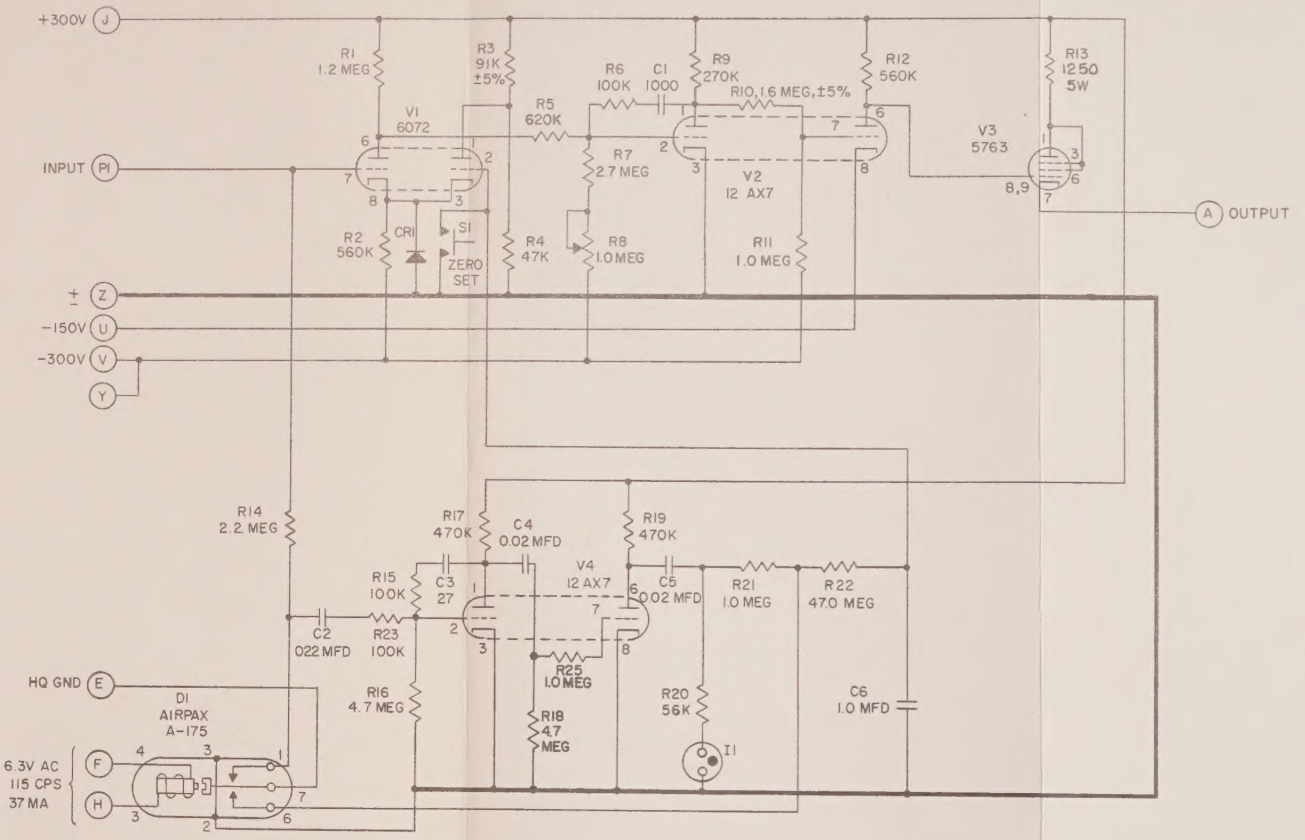


EQUIPMENT MOUNTING PLATE 99.107

WIRING D099 107 OW, SHT. 1 OF 2



NETWORK 12.091, B012 091 OS,
SCHEMATIC



NOTE:
1 UNLESS OTHERWISE SPECIFIED ALL RESISTORS HAVE RESISTANCE TOLERANCE OF ± 10% AND ARE RATED AT ½ WATT.

DC AMPLIFIER 30.33-6A-3,
C3033S6A-3, SCHEMATIC